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TM 9-723

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

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TANK-MOUNTING BULLDOZER

M3

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DEPARTMENT OF THE ARMY

JUNE 1951

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TANK-MOUNTING BULLDOZER M3



DEPARTMENT OF THE ARMY • JUNE 1951

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BY ORDER OF THE SECRETARY OF THE ARMY:

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual contains instructions for operation and organizational maintenance of the tank-mounting bulldozer M3 for the using organization and instructions for field and depot maintenance for ordnance maintenance personnel.

b. The appendix contains a list of current references, including supply catalogs, technical manuals, and other available publications applicable to the tank-mounting bulldozer M3.

c. This first edition is being published in advance of complete technical review of all concerned. Any errors or omissions will be brought to the attention of Chief of Ordnance, Washington 25, D. C., ATTENTION: ORDFM-Pub.

2. Maintenance Allocation

a. ORGANIZATIONAL MAINTENANCE ALLOCATION. In general, the prescribed organizational maintenance responsibilities will apply as reflected in the allocation of tools and maintenance parts in the appropriate column of the current ORD 7-8 SNL G-246 and in accordance with the extent of disassembly prescribed in this manual for the purpose of cleaning, lubricating, or replacing authorized spare parts. In all cases where the nature of the repair, modification, or adjustment is beyond the scope or facilities of the using organization, the supporting ordnance maintenance unit should be informed so that trained personnel with suitable tools and equipment may be provided or other proper instructions issued.

b. FIELD AND DEPOT MAINTENANCE ALLOCATION. The publication herein of instructions for complete disassembly and rebuild is not to be construed as authority for the performance by field maintenance units of those functions which are restricted to depots and arsenals. In general, the prescribed maintenance responsibilities will apply as reflected in the allocation of maintenance parts listed in the field and depot maintenance columns of the current ORD 7-8 SNL G-246. Instructions for depot maintenance are to be used by maintenance companies in the field only when the tactical situation makes the repair

functions imperative. Provisions of parts listed in the depot stock guide column of ORD 7-8 SNL G-246 will be made to field maintenance only when the emergency nature of the maintenance to be performed has been certified by a responsible officer of the requisitioning organization.

3. Forms, Records, and Reports

a. GENERAL. Forms, records, and reports are designed to serve necessary and useful purposes. Responsibility for the proper execution of these forms rests upon commanding officers of all units maintaining bulldozers. It is emphasized, however, that forms, records, and reports are merely aids. They are not a substitute for thorough practical work, physical inspection, and active supervision.

b. AUTHORIZED FORMS. The forms generally applicable to units maintaining these bulldozers are listed in the appendix. No forms other than those approved for the Department of the Army will be used. Pending availability of all forms listed, old forms may be used. For a current and complete listing of all forms, see current SR 310-20-6.

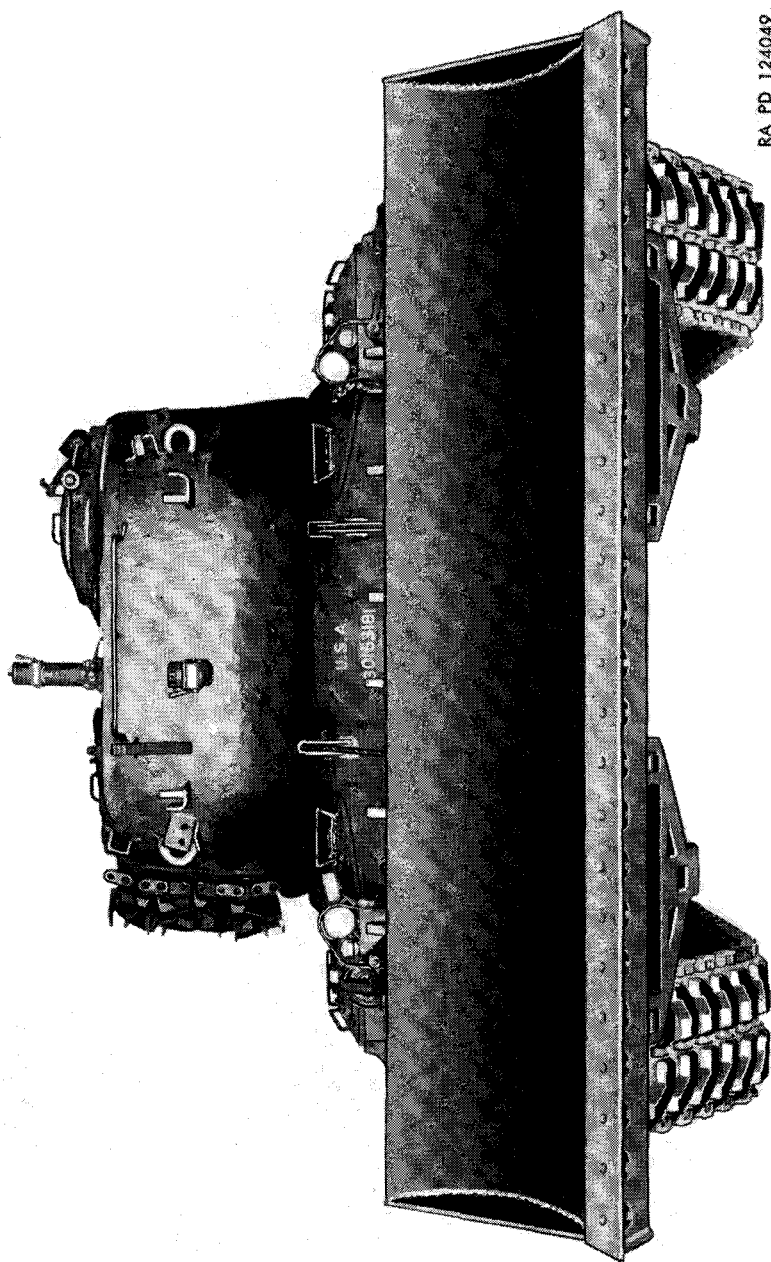
c. FIELD REPORTS OF ACCIDENTS. The reports necessary to comply with the requirements of the Army safety program are prescribed in detail in the SR 385-10-40 series of Special Regulations. These reports are required whenever accidents involving injury to personnel or damage to matériel occur.

d. REPORT OF UNSATISFACTORY EQUIPMENT OR MATERIALS. Any suggestions for improvements in design and maintenance of equipment, safety and efficiency of operation, or pertaining to the application of prescribed fuels, lubricants, and/or preserving materials, will be reported through technical channels, as prescribed in SR 700-45-5 to the Chief of Ordnance, Washington 25, D. C., ATTN : ORDFM, using DA AGO Form 468 (Unsatisfactory Equipment Report). Such suggestions are encouraged in order that other organizations may benefit.

Section II. DESCRIPTION AND DATA

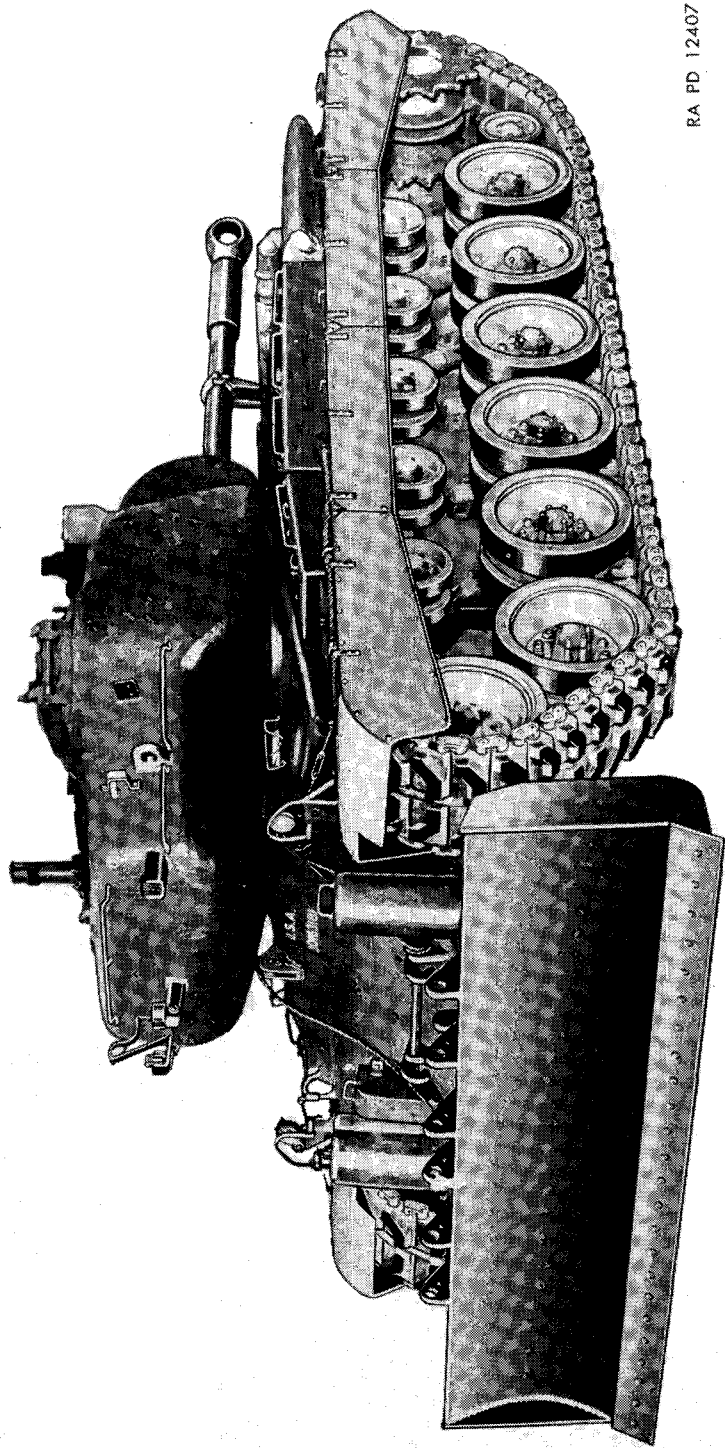
4. Description

a. The bulldozer M3 is mounted on the medium tank M46 (figs. 1 and 2) and consists primarily of a large blade mounted so that it is capable of moving earth when propelled by the vehicle. This blade is called a moldboard and is supported by two push beams installed on brackets that are welded to the front underside of the hull casting. The push beams, tilt arms, tilt links, and moldboard form a quadrilateral linkage which is operated (raised or lowered) by two double-acting cylinders.



RA PD 124049

Figure 1. Front view of bulldozer M3 mounted on medium tank M46.



RA PD 124071

Figure 2. Left-front view of bulldozer M3 mounted on medium tank M46.

b. A hydraulic pump, located in the vehicle below the turret floor and driven off the vehicle main engine, provides hydraulic pressure for operation of the cylinders. A four-way control wave, located in the vehicle below the turret floor and operated by a lever located on the hull wall at the driver's left, regulates the flow of oil to the hydraulic cylinders. Carrying hooks, operated manually by a lever over the driver's right shoulder, are provided for travel use. An emergency-lift system, for lifting the moldboard into carrying position, is provided and consists of a hand-operated pump and a single-acting hydraulic cylinder. The hand-operated pump is located to the left of the assistant driver and the hydraulic jack is in front of the assistant driver's seat.

5. Name and Instruction Plates and Decalcomanias

a. **BULLDOZER NAME PLATE.** This plate is located on the center of the rear side of the moldboard (fig. 3). It gives the manufacturer's name, model number, and serial number, and the ordnance serial number.

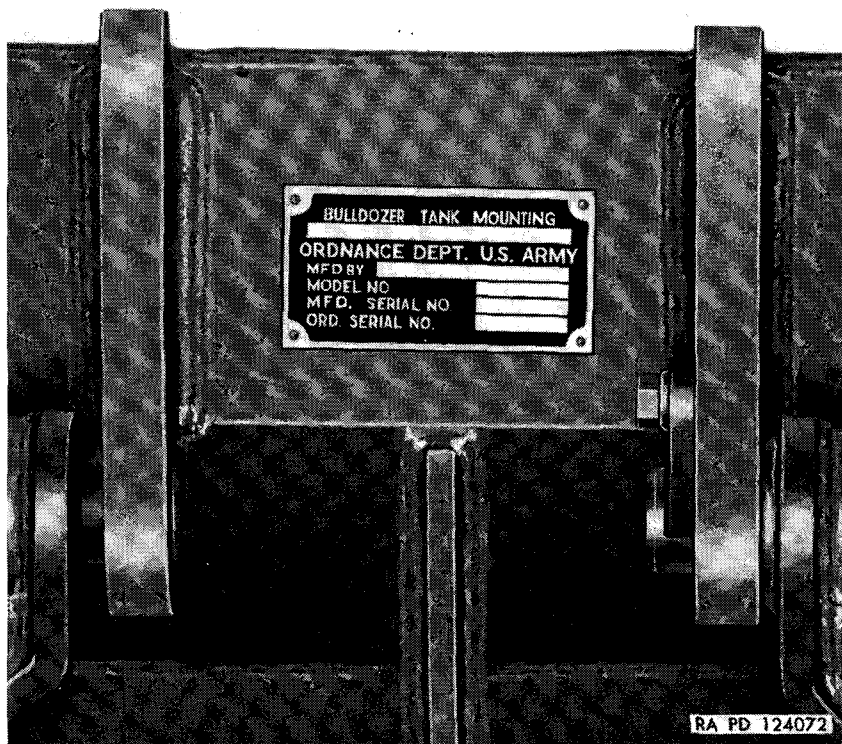


Figure 3. Bulldozer name plate.

b. **HYDRAULIC-PUMP NAME PLATE.** This plate is located at the front end of the pump (fig. 63). It gives the manufacturer's serial number and model number, and the ordnance part number.

c. **EMERGENCY-LIFT-HAND-OPERATED-PUMP NAME PLATE.** This plate is located on the right side of the pump housing just to the rear of the release-valve operating lever (fig. 46). It gives the manufacturer's serial number and model number.

d. **EMERGENCY-LIFT-WARNING DECALCOMANIA.** This "WARNING" decalcomania is affixed to the underside of the hydraulic-jack cylinder near the top. The "WARNING" reads as follows: "HAND PUMP VALVE LEVER MUST BE OPEN WHEN EMERGENCY LIFT IS USED. FOR EMERGENCY OPERATION LOCK OUT MAIN HYDRAULIC SYSTEM BY PLACING VALVE CONTROL HANDLE IN FLOAT POSITION, THEN CLOSE HAND PUMP VALVE AND OPERATE HAND PUMP LEVER."

e. **EMERGENCY-LIFT-HAND-OPERATED-PUMP WARNING DECALCOMANIA.** This "WARNING" decalcomania is affixed to the top of the pump reservoir, directly under the release-valve operating lever (fig. 46). It reads as follows: "VALVE MUST BE OPEN AT ALL TIMES EXCEPT WHEN EMERG LIFT IS USED." At the front end of the decalcomania, there is printed the word "CLOSED"; and at the rear end of the decalcomania is the word "OPEN." These words indicate the release-valve operating lever positions.

f. **CONTROL-VALVE-OPERATING-LEVER INSTRUCTION PLATE.** This plate (fig. 44) is attached to the top of the control-valve-operating-lever mounting bracket. It contains the four words "FLOAT," "LOWER," "HOLD," and "RAISE," positioned to read in a column from front to rear in the order named. These words indicate the four positions of the operating lever.

g. **CARRYING-HOOKS-OPERATING-LEVER INSTRUCTION DECALCOMANIAS.** Two separate decalcomanias, one reading "CARRYING HOOKS UP," the other reading "CARRYING HOOKS DOWN" are affixed to the vehicle hull over the driver's head (fig. 35). These decalcomanias indicate the two positions of the carrying hooks operating lever. The "CARRYING HOOKS UP" decalcomania is in front of the lever and the "CARRYING HOOKS DOWN" decalcomania is to the rear of the driver.

6. Data

a. GENERAL.

Weight (net increase to vehicle including oil).....	6,000 lb
Moldboard length.....	146 in
Moldboard height.....	36¾ in
Reversible moldboard cutting edge.....	146 x 8 x ¾ in

Angle of moldboard cutting edge (with horizontal) :

Float position----- 58°

Lowest position----- 60°

Relation of moldboard cutting edge to ground :

Carrying position----- 29 in above

Highest position----- 30¼ in above

Lowest position----- 9 in below

Vehicle angle of approach :

Carrying position----- 21°

Highest position----- 25°

b. PERFORMANCE.

Rate of lift :

Vehicle main engine at 1,500 rpm----- 5.50 in per sec

Vehicle main engine at 2,100 rpm----- 7.75 in per sec

Forward speed of vehicle while bulldozing (vehicle main engine at

1,500 rpm and low gear)----- 1 to 2 mph

Recommended maximum speed of vehicle (with bulldozer attached)----- 15 mph

CHAPTER 2

INSTALLATION AND OPERATION INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF MATÉRIEL

7. Scope

This chapter contains information for guidance of personnel responsible for the installation and operation of the bulldozer. Section I contains complete information for installation of the bulldozer on the vehicle and service upon receipt. Section II contains instructions and descriptions and locations of controls.

8. Unpacking Crated Bulldozer and Identification of Parts

a. UNPACKING THE BULLDOZER. A new bulldozer is shipped packed in two crates and on a heavy wooden skid (fig. 4).

Caution: Before opening the crates, make certain that each is placed right side up.

Remove the top from the crate by prying off the individual boards with a crowbar. Subsequent cutting of steel straps and wires which secure individual pieces inside the crates, and removal of wooden blocking pieces, will then permit all loose parts to be taken from the crates. To remove the bulldozer parts from the skid, it is only necessary to cut the steel straps used to secure it in place. As the mold-board is exceedingly heavy, a crane must be used for removing it from the wooden skid.

b. IDENTIFICATION OF PARTS. The bulldozer is shipped with many of the parts already assembled, and some of these assemblies will have to be partially disassembled prior to installation of the bulldozer on the tank. Before disassembling any of the parts, identify each assembled group or loose part to make certain that no parts are missing. Tables I and II provide a list of loose parts and assembly groups.

9. Installation of Bulldozer on Vehicle

a. GENERAL INFORMATION.

- (1) The M3 bulldozer can be mounted on any medium tank M46. Brackets, which are to be welded to the front of the hull casting, have been fabricated to tolerances which will permit their assembly on the maximum-sized casting likely to be

Table I. Bulldozer Parts as Shipped on Skid

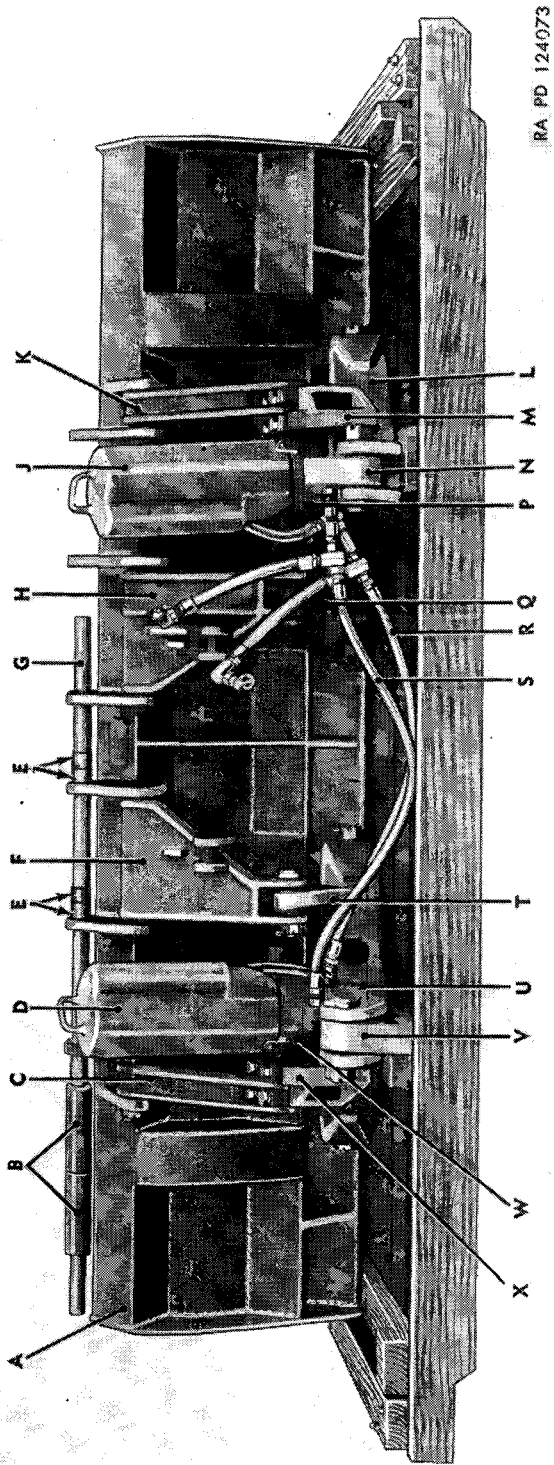
[Refer to fig. 4]

Key Letter	Item	Quantity
A	Moldboard with cutting edge.....	1
B	Alining-fixture spacer.....	2
C	Left-outer-tilt arm.....	1
D	Left-hydraulic-cylinder guard.....	1
E	Alining-fixture bushing.....	4
F	Left-inner-tilt arm.....	1
G	Alining-fixture long bar.....	1
H	Right-inner-tilt arm.....	1
J	Right-hydraulic-cylinder guard.....	1
K	Right-outer-tilt arm.....	1
L	Right push beam.....	1
M	Right-hydraulic-cylinder outer bracket.....	1
N	Right-push-beam bracket.....	1
P	Right hydraulic cylinder.....	1
Q	Right-inner-tilt-arm bracket.....	1
R	Exterior upper hydraulic lines and fittings.....	1
S	Exterior lower hydraulic lines and fittings.....	1
T	Left-inner-tilt-arm bracket.....	1
U	Left push beam.....	1
V	Left-push-beam bracket.....	1
W	Left hydraulic cylinder.....	1
X	Left-hydraulic-cylinder outer bracket.....	1

Note. All the above parts of the bulldozer are assembled in proper relation and mounted upon a skid for shipping. The alining fixture bar is passed through eyes at the top of the moldboard with the spacers and bushings around the bar.

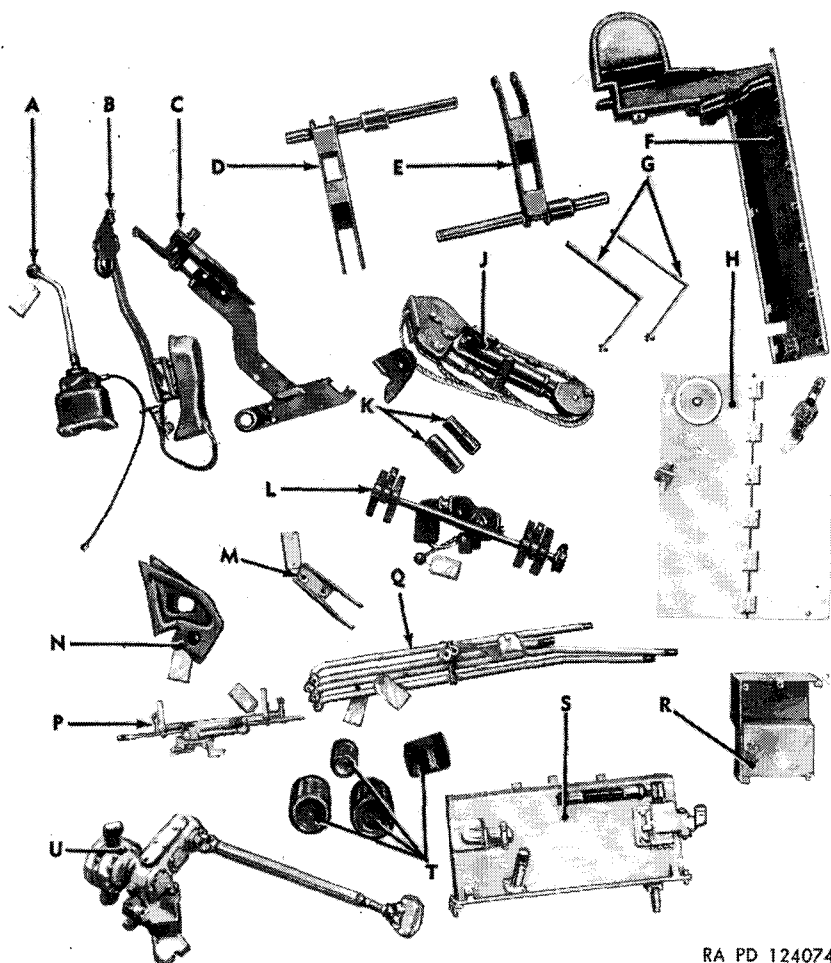
encountered (variations inherent in the manufacture of a casting of this size make it impossible to fabricate an attaching assembly—such as the bulldozer M3—which will be a perfect fit). Whenever a vehicle is encountered in which the casting has been made to smaller tolerances than the maximum, it will be necessary to shim under those brackets which the alining fixtures hold away from contact with the casting. This shimming must be accomplished before welding the brackets to the casting. The vehicle selected should be properly serviced and in good operating condition.

- (2) The bulldozer components are shipped with all rubber hoses, lines, and fittings assembled into various assemblies (figs. 4 and 5). These must be completely disassembled prior to installation and must be assembled again in proper sequence during installation, in a manner to assure leakproof connections. Use mica-base antiseize compound when assem-



RA PD 124073

Figure 4. Bulldozer parts as shipped on skid (refer to table I)



RA PD 124074

Figure 5. Bulldozer parts shipped in crates (refer to table II)

bling all line and hose connections, except line and hose unions. Use the compound sparingly to prevent any of it from entering inside the parts.

Note. Inasmuch as each assembly of lines, hoses, and fittings is correctly arranged for installation of equipment, it is recommended that each assembly be disassembled just prior to its use, instead of all the assemblies being disassembled at the same time at the beginning of the installation. It will then be easy to assemble the parts of each assembly in proper order.

b. ARRANGEMENT OF INSTALLATION INSTRUCTIONS. The installation procedure given herein is divided into six divisions. The first and second divisions of work must be performed consecutively, but the third division of work can be performed simultaneously with the first two. The fourth and fifth divisions of work can be performed simul-

Table II. Bulldozer parts shipped in crates

[Refer to fig. 5]

Key Letter	Item	Quantity
A	Emergency-lift hand-operated pump with hose for connecting the pump to the emergency-lift hydraulic jack.	1
B	Alining-fixtured-left-support plate, bar support, and left-head-light bracket and guard.	1
C	Alining-fixtured-right-support plate, bar support, and right-head-light bracket and guard.	1
D	Alining-fixtured-right-push-beam-bracket locating plate, alining-fixtured medium bar, and short spacer.	1
E	Alining-fixtured-left-push-beam-bracket locating plate, alining-fixtured medium bar, and short spacer.	1
F	Hydraulic-piping lower and upper guards, guard center plate, guard end plates, and mounting blocks and bolts.	1
G	Fender reinforcement angles-----	2
H	Turret floor plate and "MANUALS" box mounting strap---	1
J	Emergency-lift hydraulic jack-----	1
K	Alining-fixtured short bar-----	2
L	Carrying-hooks shaft, cable, and operating lever-----	1
M	Alining-fixtured-hydraulic-cylinder-inner-bracket gage-----	2
N	Hydraulic-cylinder-inner brackets-----	2
P	Hydraulic-pump control-valve and linkages-----	1
Q	Interior hydraulic lines, fittings, and mounting brackets---	1
R	Spare ration box-----	1
S	Hydraulic-pump reservoir, control valve, and fittings-----	1
T	Paint and thinner-----	7
U	Hydraulic pump, gear-drive, propeller shaft, and mounting bracket.	1

Note. These tables are not to be used for requisitioning replacements.

taneously and can be started upon completion of the second division of work. The sixth division of work can be undertaken whenever convenient, following removal of vehicle parts as directed in the first and third divisions of work. Work divisions are as follows:

- (1) Welding of brackets to the exterior of the vehicle hull (pars. 11 to 15).
- (2) Installation of moldboard and exterior hydraulic-system components (pars. 16 to 18).
- (3) Installation of interior-hydraulic-system components (pars. 19 to 27).
- (4) Installation of carrying-hooks and components (par. 28).
- (5) Installation of emergency-lift components (pars. 29 to 32).
- (6) Installation of relocated vehicle accessories (pars. 33 to 36).

Note. All locational references (right and left) to parts and assemblies—whether being installed externally or internally—are made with respect to the position of the driver of the vehicle.

10. Tools Required

All operations required for installation of the bulldozer can be accomplished with tools normally issued to automotive mechanics, and with such standard items as—a hydraulic jack, a hoist with a 2-ton or more capacity, a cutting torch, and electric-arc welder, and a 1½-inch-capacity electric drill. All special alining fixtures are furnished with each bulldozer kit.

11. Removal of Interfering Parts From Exterior of Vehicle

a. Remove the tools and tool rack (fig. 6) and cut the six mounting blocks from the hull.

Note. These blocks are to be used later in relocating the tool rack.

b. Remove the two head lights, brackets, and guards.

Note. The brackets and guards will not be reinstalled; but the lights and fittings will be installed later in a new bracket.

c. Cut away the two tow locks and brackets from the front of the hull.

Note. These locks will not be reinstalled.

d. Remove the sledge and cut away the sledge holder, handle bracket, and strap fastener.

Note. These parts are to be installed later in a new location.

e. Cut away the cable lock from the front of the hull.

Note. This lock will be installed later in a new location.

f. Remove both front-fender sections.

Note. The fender sections will be modified and reinstalled.

g. Remove the exterior guard around the cal. .30 machine gun.

Note. The complete machine gun installation is to be removed (par. 19) and will not be installed again while the bulldozer is on the vehicle.

12. Installation of Hydraulic-Cylinder Brackets

Note. Two brackets, welded to the front of the vehicle hull, support each hydraulic cylinder. The two inner brackets (N, fig. 5) for the two cylinders are shipped wired together. The two outer brackets are shipped mounted at the free ends of the respective connecting links (fig. 4). Both outer brackets are actually double brackets having two separate caps bolted onto the two integrally-cast brackets. The inner brackets are single brackets. All four brackets are numbered with figures which are cast on the brackets and are duplicated on the caps. The caps are not interchangeable and not reversible, but must be installed on the respective brackets in the exact positions indicated by the numbers. Reading from left to right across the front of the hull, the numbers of the brackets, when properly installed will be: "3," "2," "1," and "4." In addition, the outer brackets can be distinguished by the fact that the

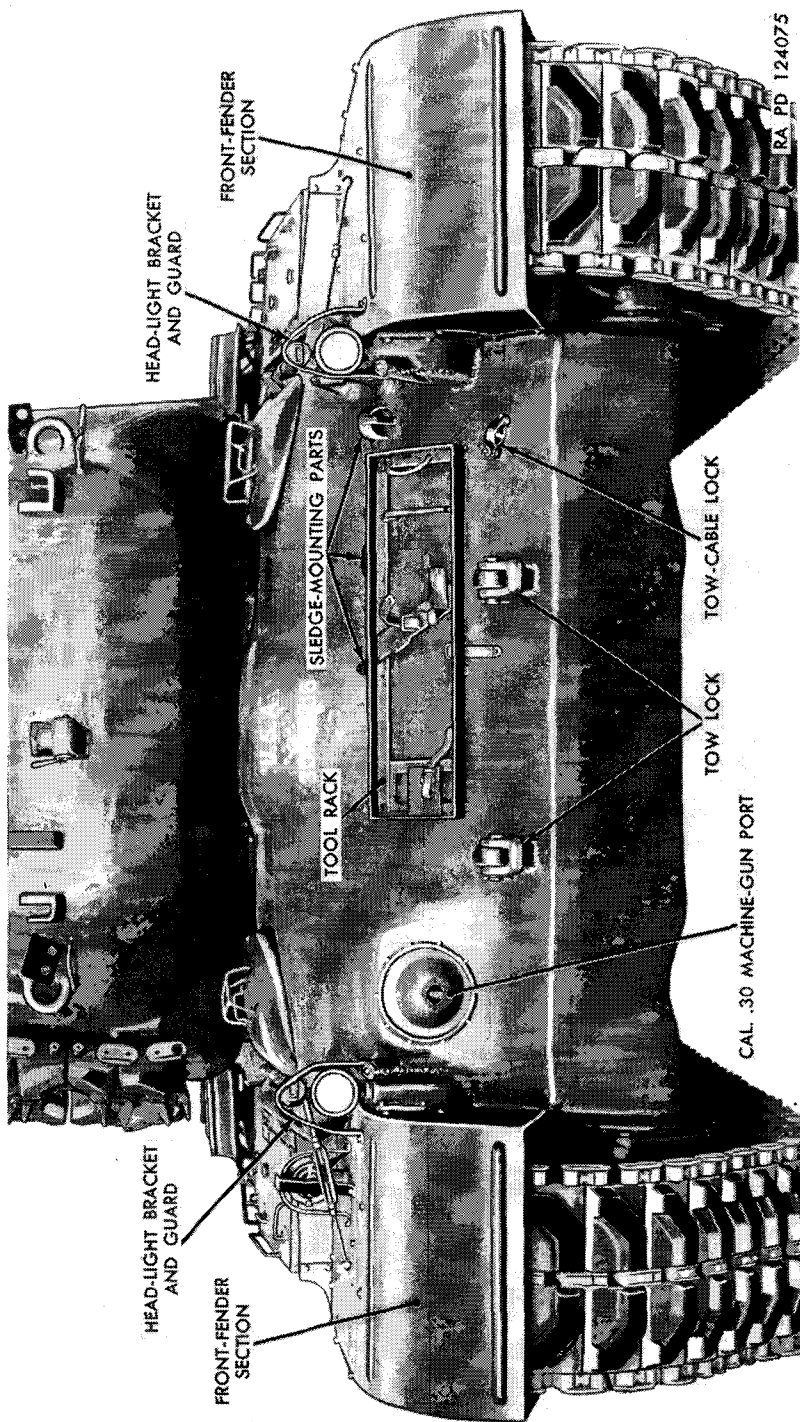


Figure 6. Exterior of medium tank M46 prior to installation of bulldozer M3.

projecting portion of each bracket is on the outer side. Actually, the two inner brackets are interchangeable, but it is advisable to install them according to the sequence noted above.

a. Remove the two head-light brackets from the respective alining-fixture support plates (B and C, fig. 5), but leave the two bar supports attached to the respective plates.

b. Loosen the foremost bolt in the circle of bolts that secure the left-front-road-wheel-arm retainer to the side of the hull, and also loosen the bolt directly below it. Turn each bolt out approximately $\frac{3}{8}$ inch.

c. Install the alining-fixture-left-support plate (B, fig. 5) at the left side of the hull by inserting the two slotted openings, which are on the rear edge of the short arm of the plate, under the heads of the bolts just loosened (figs. 7 and 8), and by drawing the bolts just tight enough to hold the plate in place. Position the plate well down onto the bolts and check to see that the short vertical plate (welded to the top of the long arm) is pressed flat against the inner surface of the adjacent fender, then tighten the two bolts securely to hold the plate in this position.

Note. The alining-fixture-left-support plate is that one which has an extra welded-on plate at the end of the long arm, on the side which will face the center line of the vehicle, when the support plate is installed.

d. Install the alining-fixture-right-support plate (C, fig. 5) in the same manner.

e. From the shipping skid remove the alining-fixture long bar (G, fig. 4), together with the two long spacers (B, fig. 4) and the four bushings (E, fig. 4). Lay this bar laterally on the ground in front of the vehicle.

f. Over each end of the long bar, install the following: one bushing, one long spacer, and two more bushings.

g. Install the bar across the front of the vehicle (fig. 7) by inserting the ends of the bar in the respective bar supports (already bolted to the alining-fixture-support plates).

Note. It may be necessary to loosen the two bolts and nuts which secure each bar support to its support plate, in order to jockey the long bar into position in the two supports. Leave both bar supports loose.

h. Remove both caps from each of the two hydraulic-cylinder-outer brackets (M and X, fig. 4), and remove the brackets from the shipping skid. Remove the caps from each of the two hydraulic-cylinder-inner brackets.

Note. Each cap is secured by two long bolts and lock washers.

i. Install the left hydraulic-cylinder-outer bracket on the extreme left end of the bar to the left side of the long spacer which was in-

stalled on this end and with the two bushings seated inside the two bores of the bracket (fig. 7).

Note. The bracket is installed by replacing the two caps on the bracket. Be sure to install each in its proper place and in the proper position with respect to the numbers cast on the face of the bracket and the faces of the caps. Do not tighten the four bolts, which secure the two caps, at this time.

j. Install the right hydraulic-cylinder-outer bracket, in the same manner, at the extreme right end of the bar.

k. Install the left hydraulic-cylinder-inner bracket over the bar at the right side of the long spacer which is at the left end of the bar, placing the remaining bushing at this end of the bar inside the bracket, and securing the cap loosely onto the bracket. When installing the cap, bolt the alining-fixture-left-cylinder-inner-bracket gage to the top of the cap with the two bolts which hold the cap to the bracket.

Note. Be sure to position the cap properly with respect to the numbers cast into the face of the bracket and cap. The alining-fixture-left-cylinder-inner-bracket gage was shipped wired to the right gage (fig. 5), and can be distinguished from the right-cylinder-inner-bracket gage by the fact that the vertical portion will face the center line of the vehicle when the projecting part of this portion is at top and back, pressed against the vehicle hull.

l. Install the right hydraulic-cylinder-inner bracket, in the same manner, at the right side of the bar, bolting the right-cylinder-inner-bracket gage on top (D, fig. 7).

m. Push the left hydraulic-cylinder-inner bracket to the left, so that the outer bracket on this side is pressed against the alining-fixture-support plate on this side, and the spacer and inner bracket are tightly pressed, in turn, against the outer bracket. Similarly, push the right hydraulic-cylinder-inner bracket outward to the right.

n. Using a ruler, locate the vertical center line of the left-hydraulic-cylinder-inner bracket, and mark the position of this center line on the face of the bracket with a prick punch; then similarly mark the center line of the right-hydraulic-cylinder-inner bracket.

o. Measure the distance between the two center lines just marked. If this distance is greater than $50\frac{1}{4}$ inches, the brackets have been pushed too far outward on the bar in *m* above. If the distance is less, the two alining-fixture-support plates are not properly positioned, so that the brackets have not been pushed out far enough toward the ends of the bar.

p. If the measurement indicates that the brackets have been pushed too far out toward the ends of the bar, slide all four brackets toward the center line of the vehicle to make the distance correct and to position the brackets symmetrically with respect to the vehicle center line. Place shims (fig. 8) between the outer faces of the two outer brackets

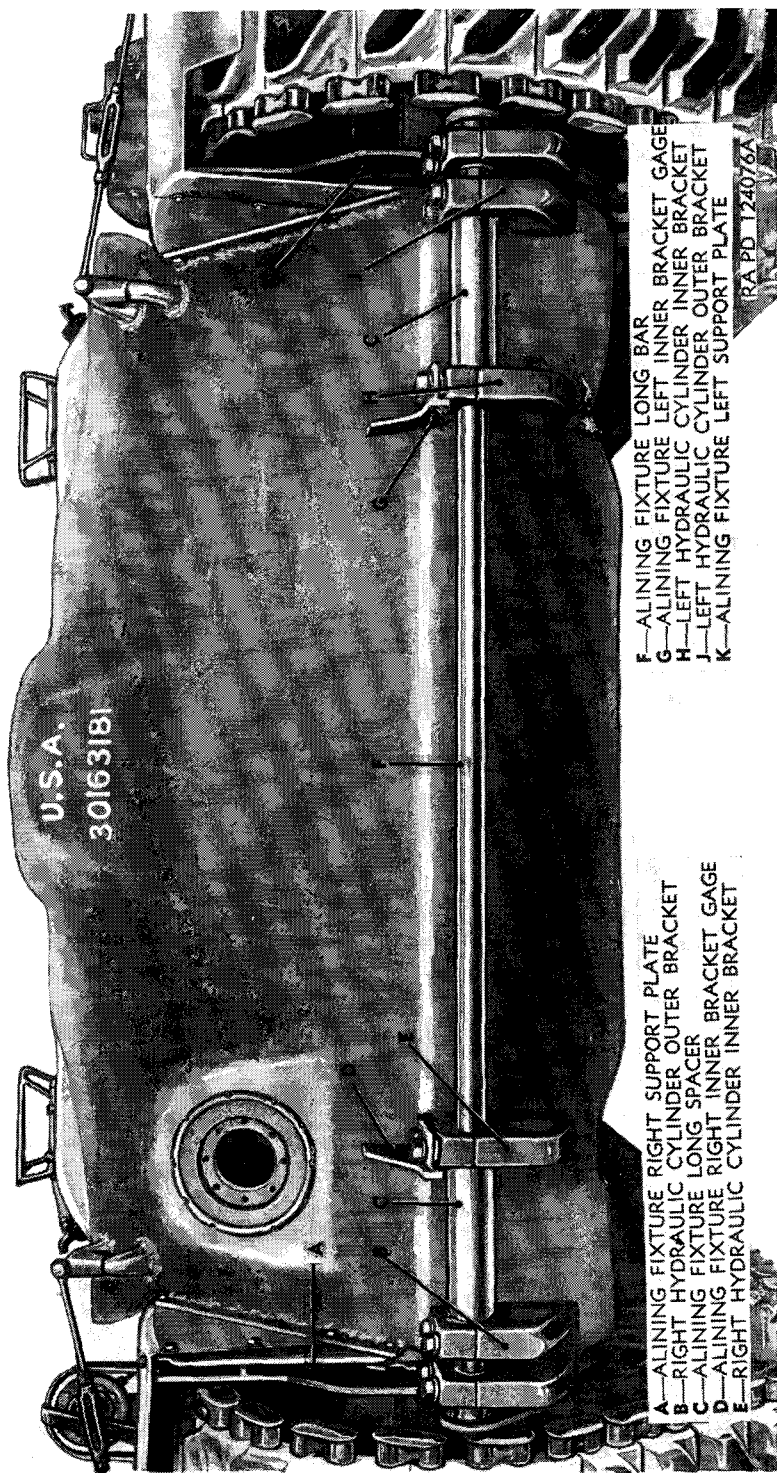
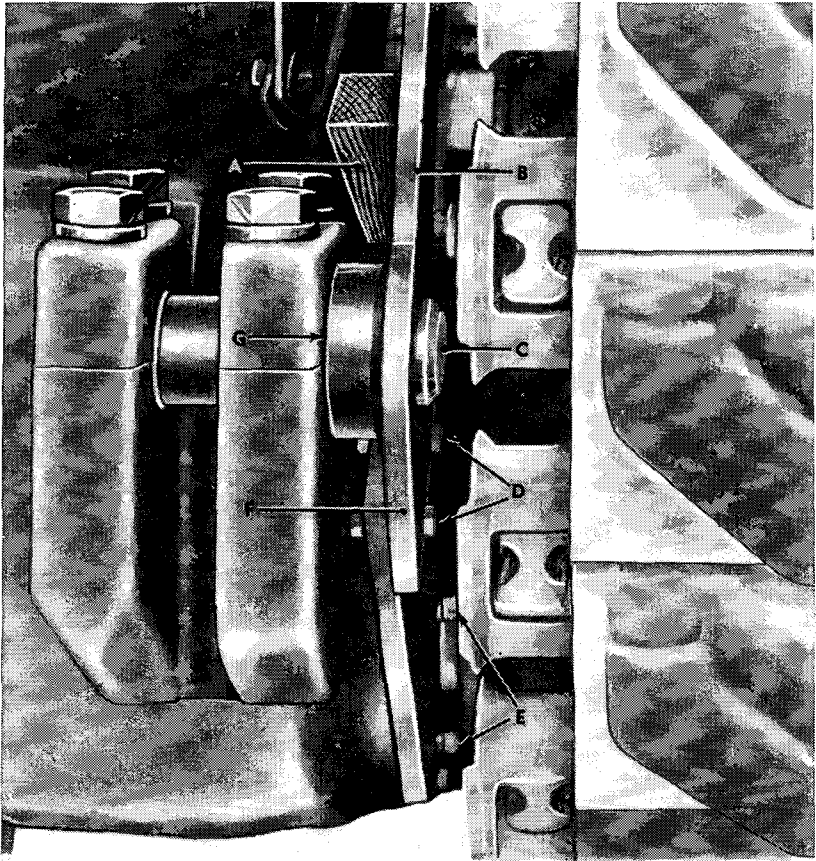


Figure 7. Hydraulic-cylinder outer and inner brackets aligned and ready for welding to hull.

and the adjacent faces of the respective support plates (to hold brackets in correct positions).

Note. When sliding brackets, be careful not to allow any separation between the spacer and brackets at each end of the bar. The group at each end, consisting of an inner bracket, a spacer, and an outer bracket, must be pressed tightly together.

g. If the measurement indicates that the brackets have not been pushed far enough towards the ends of the bar, secure equal-size



- A—WOODEN WEDGE
- B—ALIGNING FIXTURE SUPPORT PLATE
- C—ALIGNING FIXTURE LONG BAR
- D—ALIGNING FIXTURE BAR SUPPORT CAP SCREW
- E—FRONT ROAD WHEEL ARM RETAINER CAP SCREW
- F—ALIGNING FIXTURE BAR SUPPORT
- G—POINT AT WHICH SHIMS USED (IF REQD)

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Figure 8. Using a wedge to push aligning-fixture-left-support plate from vehicle hull.

wedges (fig. 8) and place one between each support plate and the adjacent portion of the vehicle hull. Tap these wedges down slowly and alternately to spread the two support plates outward by equal amounts, until the exact measurement required is obtained.

r. Have two operators, one at each end of the long bar, push the bar back toward the vehicle until the back edges of the two alining-fixture-inner-bracket gages are pressed solidly against the face of the hull, and the rear edges of the four brackets are mated as nearly as possible to the contour of the hull. Hold the bar in position and secure the two alining-fixture-bar supports tightly to the respective support plates by tightening the two bolts and nuts which hold each bar support.

Note. The bolt holes in each bar support, and also the bolt holes in the associated support plate, are slotted so that the bar supports can be moved slightly in or out and/or up or down for best possible positioning of the brackets against the hull.

s. With brackets held as in *r* above and the measurement indicated in *o* above correct, tighten all six bracket caps securely.

t. Tack weld the left hydraulic-cylinder-outer bracket to the vehicle hull at several points.

u. Similarly, tack weld the remaining three brackets to the vehicle hull.

Note. It may be necessary to loosen the cap (or caps) of each successive bracket just prior to tack welding, in order to properly position the back face of the bracket with respect to the hull. If this is necessary, be careful not to slide the brackets to right or left on the bar; also be sure to retighten the cap (or caps) prior to tack welding, so that the bracket will be raised up high enough on the bar for perfect alinement with the remaining brackets.

v. Remove the six caps from the four brackets and remove the two alining-fixture-bar supports, together with the long bar, spacers, and bushings. Do not secure the two alining-fixture-support plates.

w. Securely weld all four brackets to the hull with a $\frac{3}{4}$ -inch weld all the way around each bracket.

Note. Prior to welding, recheck the measurement given in *o* above. If the distance is incorrect, or if any of the brackets are out of perfect alinement with the other brackets, break the tack welds and repeat steps *o* to *w*.

13. Installation of Head-Light Brackets and Guards

Note. The two head-light brackets and guards are shipped bolted to the two alining-fixture-support plates (fig. 5), but have already been removed from the plates (par. 12). The left-head-light bracket is wider and approximately square at the base, while the right-head-light bracket is narrower and has a pointed projection on the side toward the center line of the vehicle, so that it will fit over the contour of the cal. .30 machine-gun port on this side of the hull. Both brackets have the guards already welded on.

a. Locate and cut two holes approximately $\frac{3}{8}$ inch in diameter through the inner vertical portion of the left-front fender section at positions which will serve for bolting the left-head-light bracket to the fender with the same two bolts and nuts with which the head light was attached to the alining-fixture-support plate.

Note. The bolt holes which are in the short vertical plate welded to the top of the support plate indicate the proper positions for the head-light-bracket holes. This plate presses against the track side of the vertical portion of the fender (fig. 9), and there is no clearance under the fender for punch marking and drilling the holes. Consequently, the holes must be located and marked on the outside of the fender (opposite the support plate). Each hole can be located within one-sixteenth inch by measuring the distance between the proper hole in the support plate and the front edge of the fender, and by then transferring this distance to the opposite side of the fender along a line parallel to the line of original measurement. Because the holes must be located by these approximate measurements, it is recommended that they be cut with a torch instead of being drilled. If drilled, they must be located to fractional accuracy; but if cut with a torch, each hole can be made round and approximately $\frac{3}{8}$ inch in diameter, which will be enough over size to allow for an inaccuracy in measurement up to one-sixteenth inch, but will be small enough to keep the nut from working through the fender after the bracket is bolted in place.

Before cutting the two holes with a torch, remove the support plate. Be sure to retighten the two bolts that secure the left-front-road-wheel-arm retainer to the hull.

b. Secure the left-head-light bracket to the fender, using the two bolts, nuts, and washers with which it was attached to the support plate.

c. Center punch and drill two $\frac{1}{4}$ -inch holes through the top of the left fender at positions which will permit bolting of the head-light guard to the fender. Secure the guard to the fender using two bolts, nuts, and washers.

d. Check to make certain that the head-light bracket is positioned vertically, is pressed tightly against the side of the fender, and is also pressed down squarely against the vehicle hull (fig. 9), then tack weld it at bottom to the hull at several points.

e. Securely weld the bracket to the hull with a $\frac{1}{4}$ -inch weld all the way around the base of the bracket.

f. Hold the right-head-light bracket up against the side of the right fender, and as nearly in its correct mounting position as possible.

Note. Because the bottom edge of this bracket must exactly fit the contour of the cal. .30 machine-gun port, it is made slightly oversize, and the bracket cannot be pushed all the way back into place at this time.

Sight a contour line, along the bottom edge of the bracket, which will match the contour of the machine-gun port when the bracket is pushed back into proper place, and mark this line with chalk or pencil.

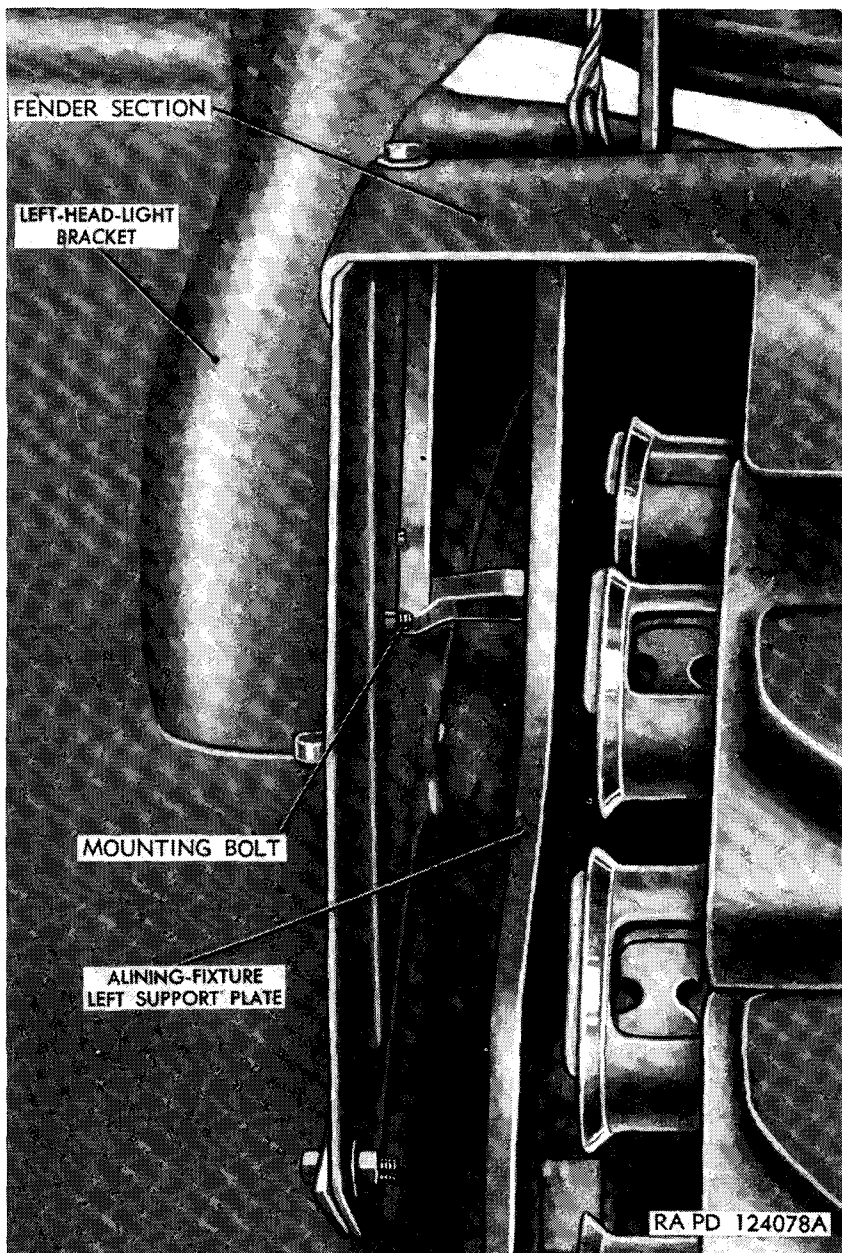


Figure 9. Locating left-head-light bracket.

g. Cut away the bottom of the bracket along the marked contour line.

h. Secure the right-head-light bracket and guard to the right fender, in the same manner in which the left bracket and guard have been secured to the left fender.

i. Make certain that the bracket is positioned vertically, is pressed against the fender, and is pressed down against the vehicle hull, then tack weld it at several points to the hull (fig. 9).

j. Securely weld the bracket to the hull with a $\frac{1}{4}$ -inch weld all the way around the base of the bracket.

14. Installation of Push-Beam Brackets and Tilt-Arm Brackets

Note. The two push-beam brackets (N and V, fig. 4) are shipped attached to the outer ends of the push beams (L and V, fig. 4). Each is secured by a pin with a castle nut and split cotter pin. The tilt-arm brackets (Q and T, fig. 4) are shipped attached to the ends of the tilt arms, and each is also secured by a pin with castle nut and split cotter pin.

a. Remove the two push-beam brackets and the two tilt-arm brackets from the shipping skid.

b. Slide the alining-fixture short spacer and the alining-fixture-push-beam-bracket locating plate from one of the alining-fixture medium bars (D, fig. 5). Disassemble the other bar and fixtures (E, fig. 5) in the same manner.

c. Install one alining-fixture medium bar (D, fig. 10) through the two hydraulic-cylinder brackets (B and E, fig. 10) at one side of the vehicle, placing one of the two alining-fixture-push-beam-bracket locating plates (C, fig. 10) over the bar in the space between the inner and outer brackets.

Note. The bar is to be pushed only halfway through the outer bracket so that it is actually supported only by the inner portion of the bracket. Alining-fixture bushings are to be placed inside this portion of the outer bracket and inside the inner bracket, around the bar. The push-beam locating plate is installed with the eye at the long end around the bar, and so that the short leg of the fixture projects down and back under the front of the vehicle hull.

d. Install the remaining medium bar and push-beam locating plate at the other side of the vehicle hull, in the same manner.

e. Over the inner end of each bar install one alining-fixture short spacer (F, fig. 10), pushing the spacer outward against the inner face of the adjacent hydraulic-cylinder-inner bracket.

f. Over the inner end of each bar, install one tilt-arm bracket (G and H, fig. 10), pushing the bracket outward against the adjoining spacer.

Note. The two tilt-arm brackets are interchangeable, but each is installed with the long pointed end at top.

g. Into the free lower end of each push-beam locating plate, install one of the alining-fixture short bars. These bars are to be installed so that each projects out of the fixture toward the center line of the vehicle.

Note. These two bars are shipped loose in one of the crates (fig. 5).

h. Over the projecting inner end of each short bar, install one push-beam bracket (N and P, fig. 10). Each bracket is installed with the shorter end (marked "FRONT") at front and at top.

Note. The two push-beam brackets are interchangeable and reversible in position. They should, however, be installed as directed.



i. Hold the left tilt-arm bracket tightly against the adjacent short spacer and position the back end to mate as well as possible with the adjoining portion of the vehicle hull. Tack weld it to the hull at several points.

j. Tack weld the other tilt-arm bracket to the hull, in the same manner.

k. Have one operator swing the left push-beam-bracket locating plate backward while another operator, using an automotive-type jack, raises the push-beam bracket up against the vehicle hull (fig. 10). After the bracket is raised, carefully inspect the bracket to make certain that it is positioned with the center line of the bracket eye in alinement with an imaginary bar placed laterally across the front of the hull in a manner to be supported by the two push-beam brackets. Check to make certain that the push-beam-bracket locating plate has been pushed straight backward without tilting or distortion. Tack weld the bracket to the hull at several points.

l. Locate and tack weld the other push-beam bracket, in the same manner.

m. Check for perfect alinement of the two push-beam brackets by holding the alining-fixture long bar up close to the bracket eyes at front and back to note whether or not it could be passed through both eyes and suspended so as to be laterally across the front of the vehicle.

n. Remove all of the alining fixtures.

Note. In order to remove the two medium bars, it will be necessary to remove the caps of the brackets which hold them. Be sure to replace the caps properly upon the brackets, but do not bolt them on tightly at this time.

o. Securely weld the two push-beam brackets and the two tilt-arm brackets to the hull of the vehicle with a $\frac{3}{4}$ -inch weld all around the base of each bracket.

15. Installation of Hydraulic-Piping Guard Plates

Note. There are three hydraulic-piping guard plates: a long center plate, and two identical short plates installed at the ends of the center plate. These are shipped in an assembly with the hydraulic-piping lower and upper guards (fig. 5). The two guards are bolted together in proper assembly position, and the center plate is bolted to the horizontal guard. The two end plates are tied inside the box formed by the lower guard and center plate.

a. Untie the two end plates from the assembly. Remove four bolts and lock washers and remove the center plate from the lower guard. Untie the 15 small mounting blocks from the assembly.

b. Bolt four of the mounting blocks to one of the end plates, securing each with the bolt and washer that was shipped installed in the mounting block.

c. Position one end plate up against the under sides of the right hydraulic-cylinder inner and outer brackets (fig. 11) with the cutaway edge of the plate at front, and the back edge of the plate flush against the vehicle hull.

Note. The plate is just long enough to reach from approximately the center of the inner bracket to approximately the center of the inner half of the outer bracket. Use an automotive-type jack to hold the plate in position (fig. 11). The outer sides of the four mounting blocks will be pressed against the adjacent brackets when the plate is properly located.

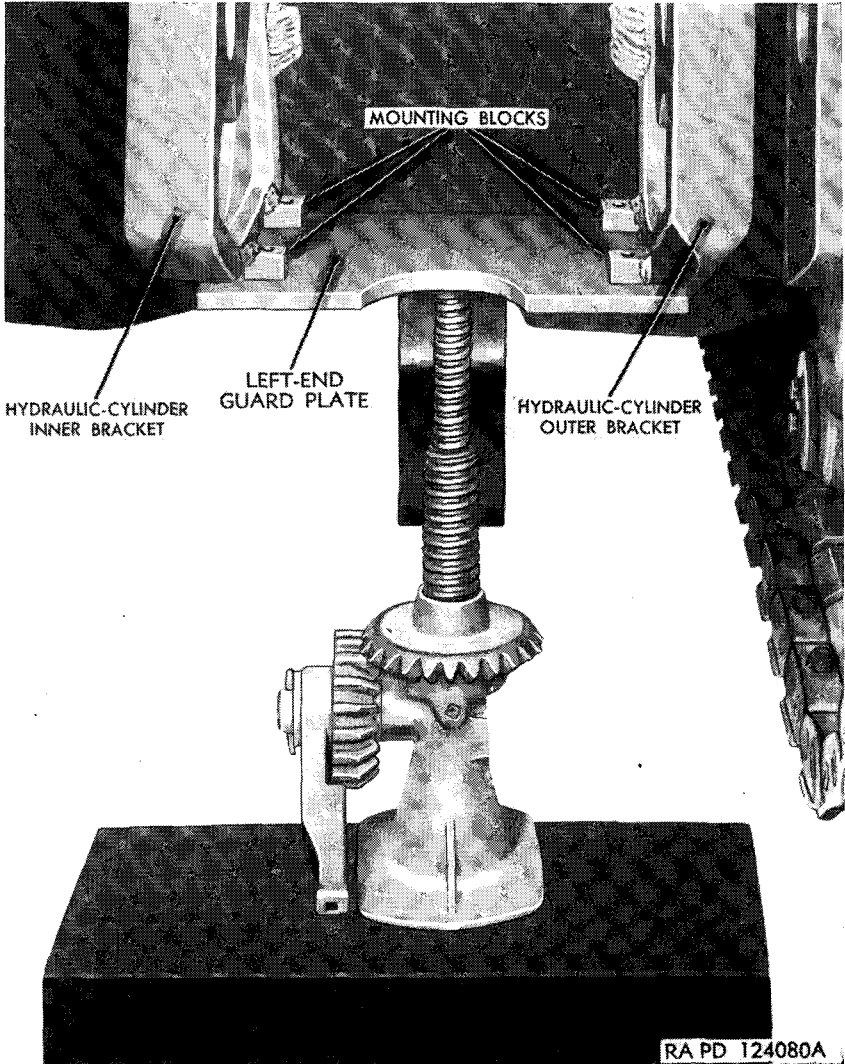


Figure 11. Using jack to hold hydraulic piping left-end guard plate to locate mounting blocks.

d. Tack weld the four mounting blocks to the adjacent brackets.

e. Remove the four bolts and washers and remove the end guard plate from the mounting blocks, then weld each mounting block to the adjacent bracket with a $\frac{1}{4}$ -inch weld at back, across the top, and at front.

Note. When welding, be careful not to close the bolt holes in the mounting blocks or to get weld on the undersides of the blocks where it would interfere with installation of the plate.

f. Secure the plate to the four mounting blocks with the four bolts and washers. Tighten the bolts securely.

g. Position the remaining end plate up against the under side of the left hydraulic-cylinder inner and outer brackets and install in the same manner.

h. Place the hydraulic piping center guard plate up against the under sides of the two hydraulic-cylinder-inner brackets with the straightedge having welded-on mounting blocks at the front, and the back edge flush up against the vehicle hull (fig. 12).

Note. This plate is just long enough to reach from approximately the center of one inner bracket to the center of the other inner bracket, so that its ends almost touch the edges of the end plates already installed. Use two automotive-type jacks to hold the plate in this raised position.

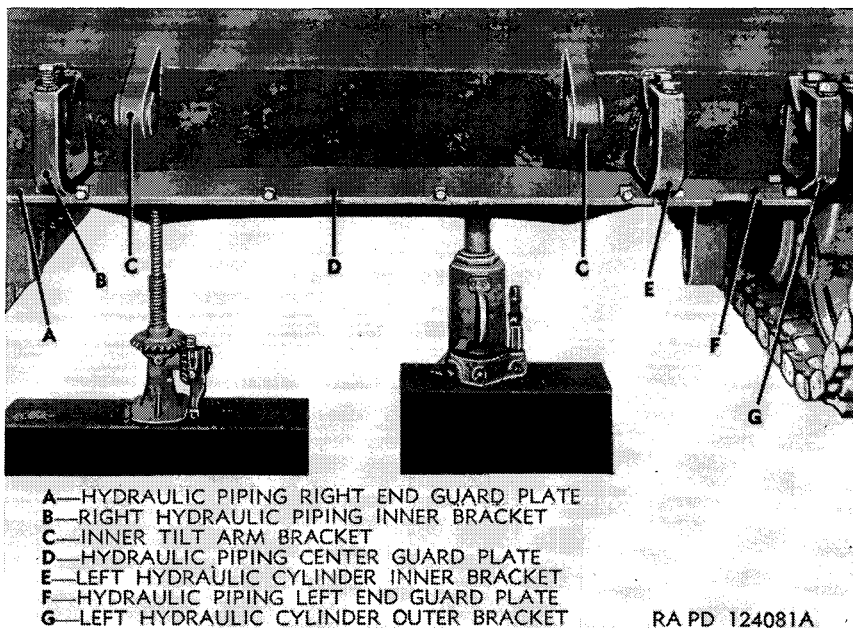


Figure 12. Using jacks to hold hydraulic-piping center guard plate for welding.

i. Weld the plate to the under side of each bracket with a $\frac{3}{16}$ -inch weld along each end of the plate.

Note. Be careful not to run the weld over onto the adjoining end plate, or to allow it to interfere with removal of the end plate in any way.

Weld between the plate and each bracket and between the plate and the vehicle hull with a $\frac{1}{4}$ -inch weld all the way around the top edges of the plate.

16. Installation of Hydraulic Cylinders

Note. The two hydraulic cylinders are shipped on the shipping skid with the respective hydraulic-cylinder guards in place over the cylinders (fig. 4). It is not necessary to remove the guards in order to install the cylinders on the vehicle; in fact, it will be easier to install them with the guards in place. The ram of each cylinder is attached to the associated push beam by a pin, castle nut, and cotter pin. The two cylinders are connected together by exterior hydraulic lines.

a. Remove all of the exterior hydraulic lines and fittings which can be removed without removal of the hydraulic-cylinder guards (fig. 4).

b. Remove the pins which attach the two hydraulic-cylinder rams to the respective push beams. Remove the two cylinders from the shipping skid.

c. Remove the two long bolts and washers which secure each hydraulic-cylinder-bracket cap. Remove the caps from the two hydraulic-cylinder-inner brackets and from the inner halves of the two outer brackets.

d. Fasten a hoist chain to the handle on top of the right hydraulic-cylinder guard, and raise the guard (with cylinder attached) into position between the right hydraulic-cylinder-inner bracket and the inner half of the outer bracket (fig. 13).

Note. The right hydraulic cylinder can be recognized by the fact that the open portion at the bottom of the guard will be facing the center line of the vehicle when the cylinder is installed with the stub shafts (at the bottom of the cylinder) resting in the brackets.

e. Position the caps on the two brackets into which the cylinder has been installed, making certain that each cap is placed on the correct bracket and in the proper position in accordance with the numbers cast in the faces of the brackets and caps. Do not tighten the caps securely at this time.

f. Install the left hydraulic cylinder and guard in the same manner.

Note. The hydraulic lines and fittings removed from the shipping skid (a above), are now to be installed in the same order of assembly in which they were received. When installed, the hydraulic lines will pass over the top of the hydraulic-piping-guard center plate, underneath the two tilt-arm brackets, and through the hollow portions at the bottoms of the respective hydraulic-

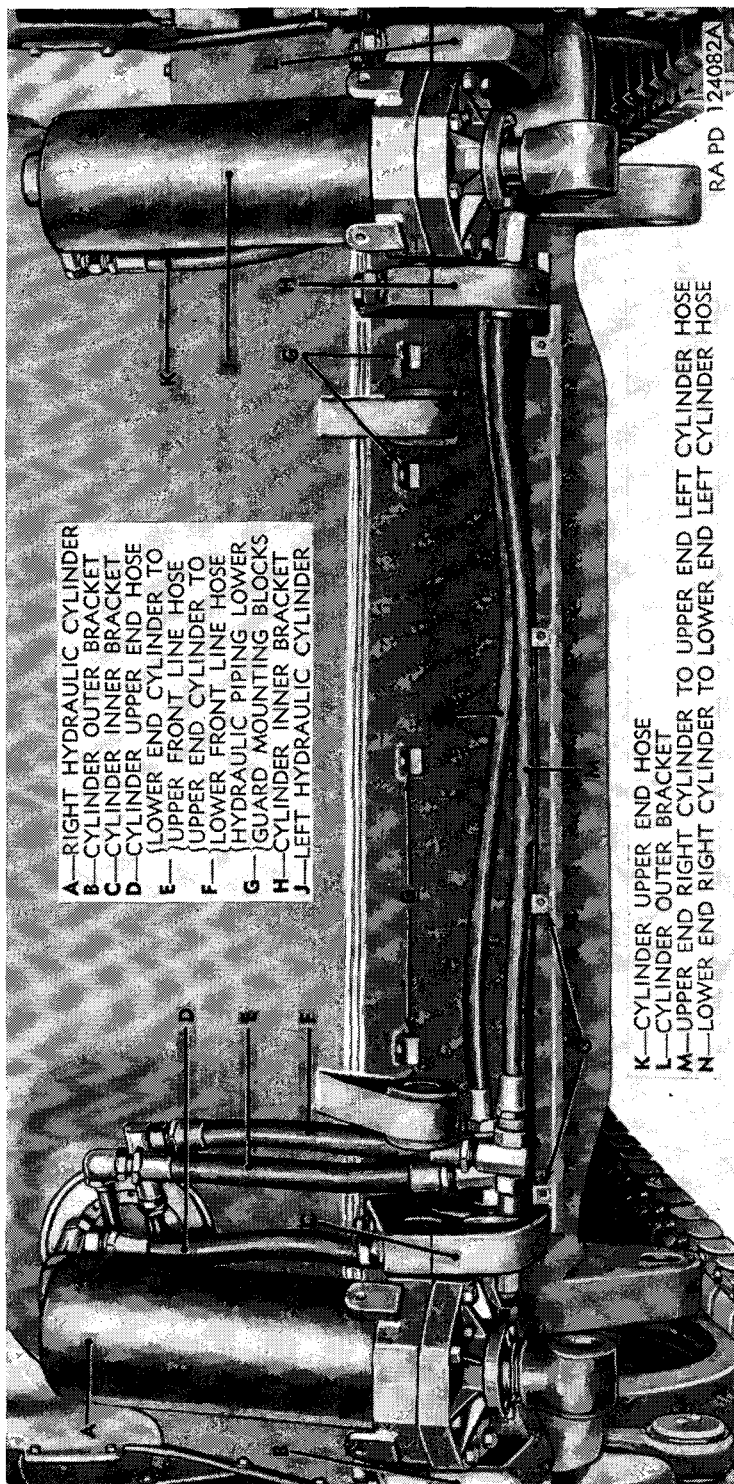


Figure 13. Hydraulic cylinders and exterior hydraulic lines.

cylinder-inner brackets. The two short hoses are coupled into the two lines between the cylinders at a point midway between the right hydraulic-cylinder-inner bracket and the right tilt-arm bracket. The sequence of coupling operations is as follows:

g. Into the opening at the bottom of the right hydraulic cylinder, install a 90-degree union elbow, a nipple, a double-union tee, and one of the two long hoses.

h. Into the opening at the bottom of the left hydraulic cylinder, install a 90-degree union elbow.

i. Connect the free end of the long hose (*g* above) to the union elbow installed in the left hydraulic cylinder.

j. Into the open side of the tee (*g* above), install one of the two short hoses and loosely attach a 90-degree union elbow to the free end of this short hose.

k. At the free end of the hose hanging down from the top of the right hydraulic cylinder, install a 90-degree union elbow, a 3-inch close nipple, a double-union tee, and the remaining long hose.

l. At the free end of the hose hanging down from the top of the left hydraulic cylinder, install a 90-degree union elbow, then connect the free end of the long hose (*k* above) to this elbow.

m. Into the open side of the tee (*j* above), install the remaining short hose and, at the free end of this hose, loosely install a 90-degree union elbow and a 45-degree pipe elbow.

n. Tighten all fittings securely, except those installed at the free ends of the two short hoses, but be careful not to twist the hoses.

17. Installation of Hydraulic-Piping Guards

Note. The two hydraulic-piping guards—a lower guard and an upper guard—are shipped bolted together (par. 15). The center plate, end plates, and mounting blocks have already been removed from this assembly.

a. Remove two bolts and washers and separate the upper guard from the lower guard.

b. Lift the lower guard into place at the front of the vehicle with the handle at top, the lower-front edge flush against the four mounting blocks welded to the front edge of the hydraulic-piping-guard center plate, and the back edge flush against the vehicle hull. Aline the four bolt holes in the lower-front edge of the guard with the mounting blocks, and secure the guard to the four mounting blocks with four bolts and washers.

Note. This guard has a cutout area to fit around the left tilt-arm bracket, and may require some jockeying to fit it properly in place.

c. In the center bolt hole at the top edge of the guard, place one of the bolts used to secure the guard to the mounting blocks which

are to be welded to the hull at this position. Draw a vertical center line across the head of the bolt; then extend this center line back so that it is marked on the adjacent portion of the vehicle hull (fig. 14).

d. Similarly, mark the center lines of the remaining two bolt holes on the hull.

e. Draw a line on the hull along the top edge of the guard, between the two tilt-arm brackets. This will establish the line at which the top of the guard meets the hull.

f. Remove the guard from the vehicle.

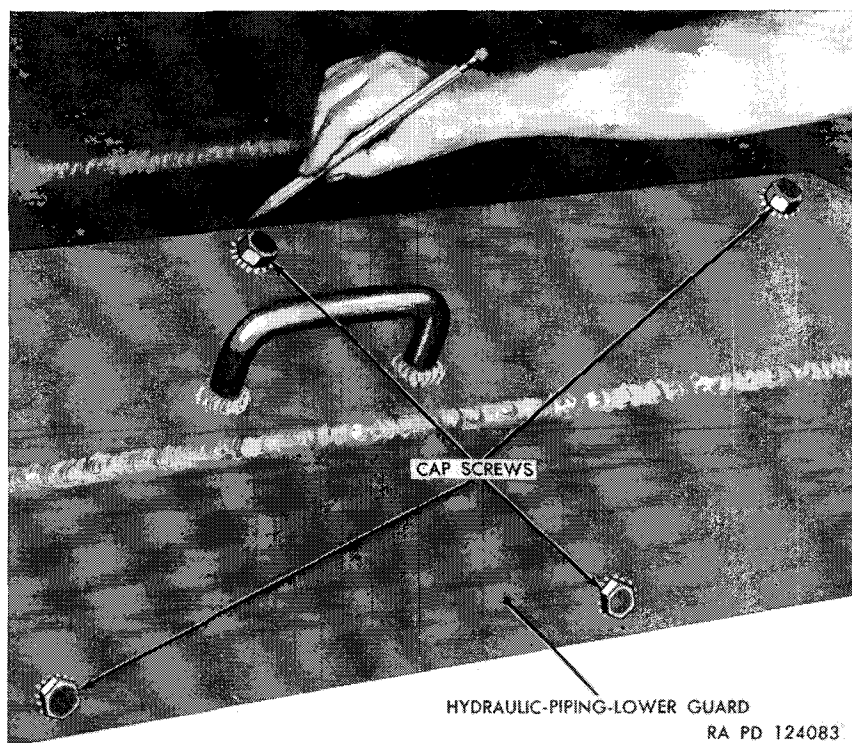


Figure 14. Locating hydraulic-piping-lower-guard mounting blocks.

g. Measure the thickness of the guard at the top edge. Place one of the small mounting blocks (par. 15) against the hull so that the bolt hole in the mounting block is in alignment with the mark used to indicate the center of the center bolt hole (c above), and with the top of the mounting block a distance below the horizontal mark on the hull that is equal to the measured thickness of the top edge of the guard. Tack weld the block in this position, making certain that the top face of the block is horizontal.

h. In similar manner, locate, and tack weld two more mounting blocks to the hull at positions to receive the remaining two bolts which will hold the top edge of the guard (fig. 13).

i. Position the guard in place and check to make certain that each of the three mounting blocks is properly installed to receive the bolt which secures the guard to the block.

Note. If any one of the mounting blocks is out of alinement, remove the guard, knock the block away from the hull, repeat the process of locating, and tack weld it to the hull.

j. Again remove the guard, then securely weld each mounting block to the hull with a $\frac{1}{4}$ -inch weld at each side and across the bottom.

Note. Be careful not to block the bolt hole when welding, not to twist the mounting block out of position, and not to get any weld on the top side of the block where it would interfere with installation of the guard.

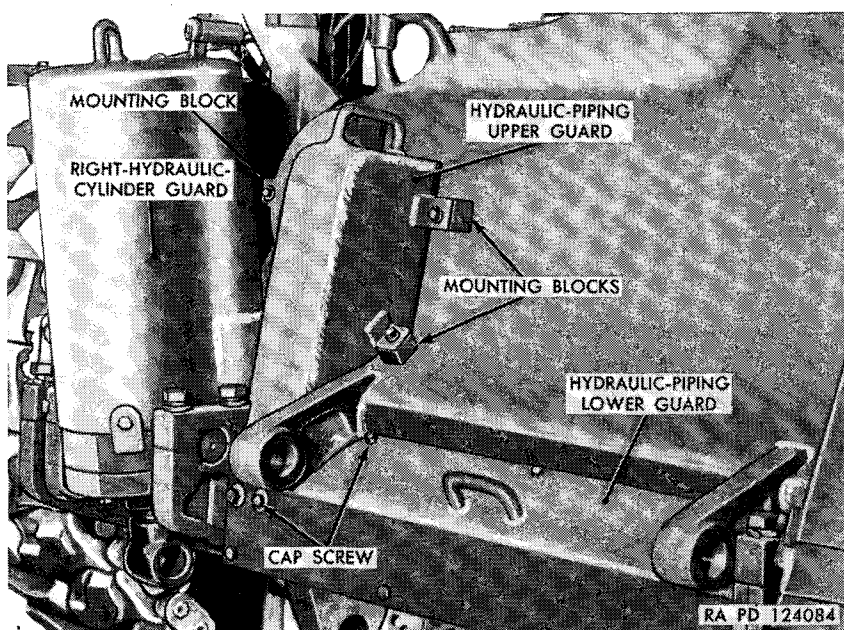


Figure 15. Hydraulic-piping upper and lower guards.

k. Again position the guard and secure it in place with four bolts and washers along the bottom edge and three bolts and washers along the top edge (fig. 15).

l. Place the hydraulic-piping upper guard in position with the handle at top and the bottom end projecting down inside the lower guard, between the right hydraulic-cylinder-inner bracket and the right tilt-arm bracket. Secure the upper guard to the lower guard with the two bolts and washers (par. 15).

m. Secure three of the mounting blocks (par. 15) to the upper guard by attaching them to the three lugs welded to the guard, using a bolt and washer for each.

n. Press the guard backward so that the three mounting blocks are flush against the vehicle hull, and tack weld each block to the hull at several points.

o. Remove the upper guard by taking out the three bolts and washers which attach it to the three mounting blocks, and the two bolts and washers which attach it to the horizontal guard.

p. Securely weld each of the three mounting blocks to the hull with a $\frac{1}{4}$ -inch weld all around.

q. Position the upper guard and secure it to the three mounting blocks and to the lower guard (fig. 15).

18. Installation of Moldboard Assembly

Note. The shipping skid (fig. 4), at this point, still contains the moldboard with the two push beams, the two outer tilt arms, and the two inner tilt arms attached. The moldboard is installed with these parts attached.

a. Raise the moldboard into position in front of the vehicle with the cutting edge resting on the ground and the mold board held in approximately vertical position by the hoist.

Note. Use a double sling to raise the moldboard, and attach the two hooks to any pair of symmetrically-located eyes on the top edge of the moldboard.

b. Pass a chain around the projecting boss on top of the moldboard at the right end, pass one end of this chain through the small opening in the outer side of the right push beam; then tie the two ends of the chain together so that the chain will support the push beam and keep it approximately level with the ground when the moldboard is raised into the air (fig. 16).

c. In the same manner, use a chain to support the left push beam.

d. Place one operator under the front of the vehicle and have two operators stand in front of the moldboard ready to push it in toward the vehicle (fig. 16). Raise the moldboard into the air until the free end of the right push beam is raised up into approximate horizontal alinement with the right push-beam bracket.

e. Jockey the moldboard to aline the pin hole in the push beam with the pin hole in the bracket. When alined, install the pin, inserting it from the inner side toward the outer side, and secure it with a castle nut and cotter pin.

f. Remove the chain which supported the right push beam; then proceed to secure the left push beam to its bracket, in the same manner.

g. Move the two outer tilt arms and the two inner tilt arms upward and forward so that the free ends of these members rest upon the top edge of the moldboard.

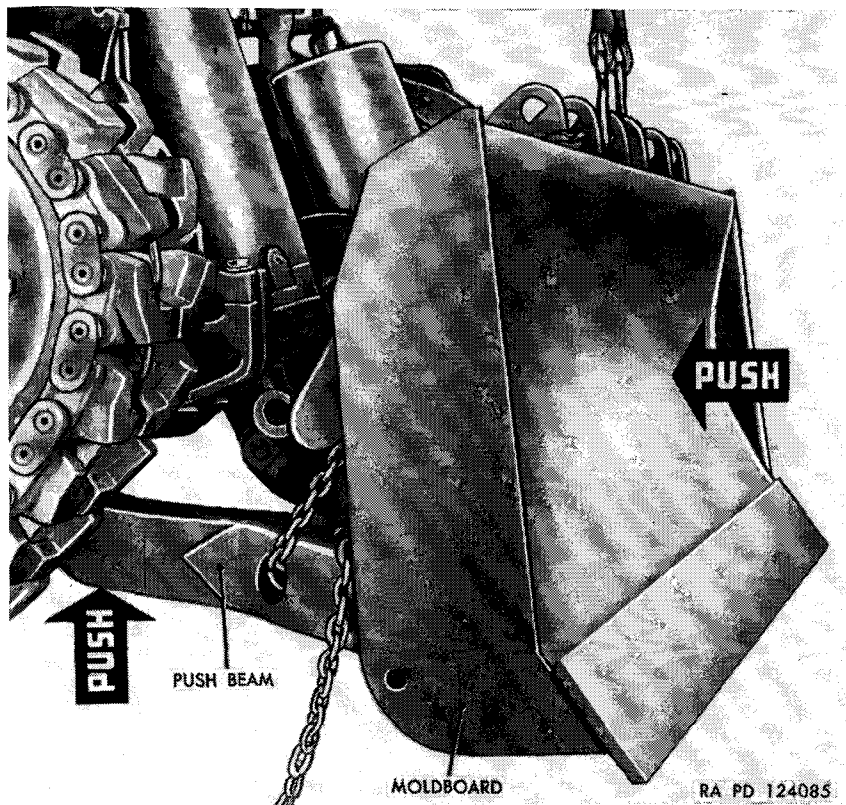


Figure 16. Positioning moldboard to align push beam with push-beam bracket.

h. Lower the moldboard until the cutting edge rests on the ground and the top edge swings in toward the vehicle far enough so that one of the inner tilt arms can be rotated back and down to place the yoke (formed at the free end of this arm) around the associated tilt-arm bracket.

i. Jockey the moldboard to align the pin holes at the free end of this tilt arm with the pin hole in the bracket, then install the pin, inserting it from the inner side toward the outer side (fig. 17) and securing it with a castle nut and cotter pin.

Note. When installing the pin, push it through just far enough to start the nut on the pin. (If it is pushed all the way through, there will not be room between the end of the pin and the adjacent hydraulic-cylinder-inner bracket to install the nut.) Run the nut up on the pin, tapping the pin in as additional clearance is gained for the nut. It is possible that there may be interference between the adjacent hydraulic-piping guard and the nut or the head of the pin. If this is the case, the interfering guard will have to be ground down to provide clearance.

j. Install the pin which secures the other inner tilt arm to its bracket, again jockeying the moldboard to align the pin holes.

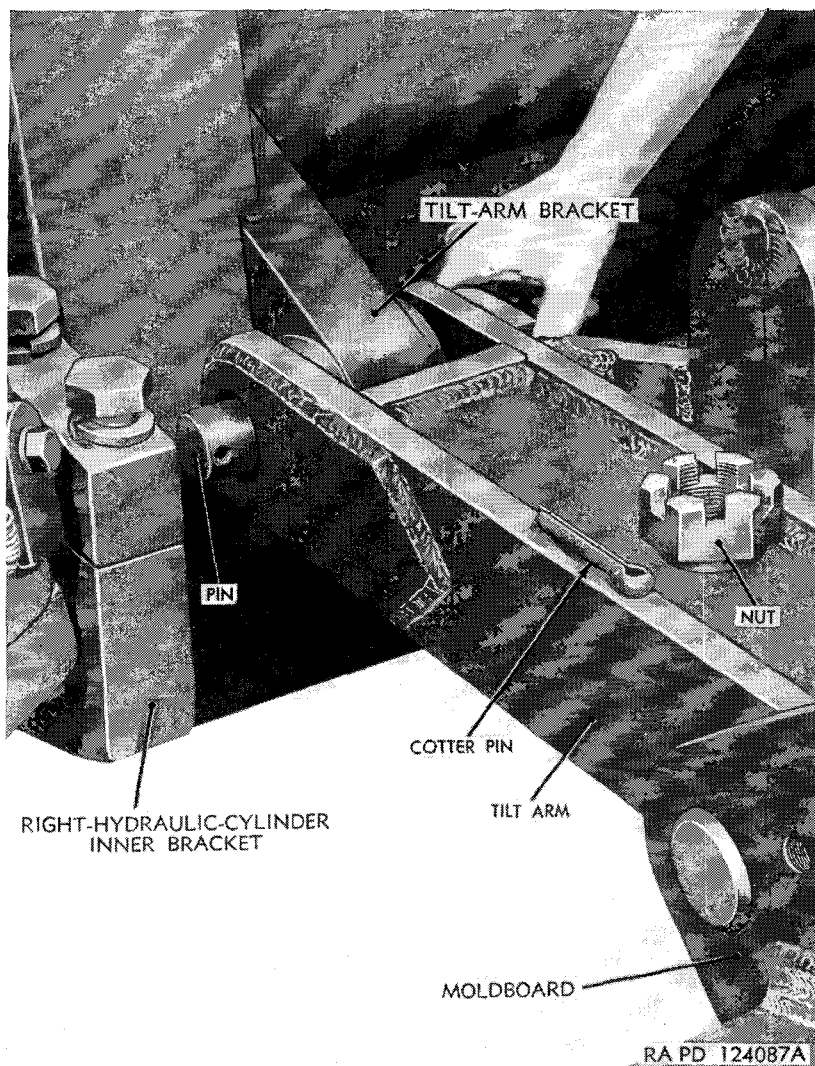
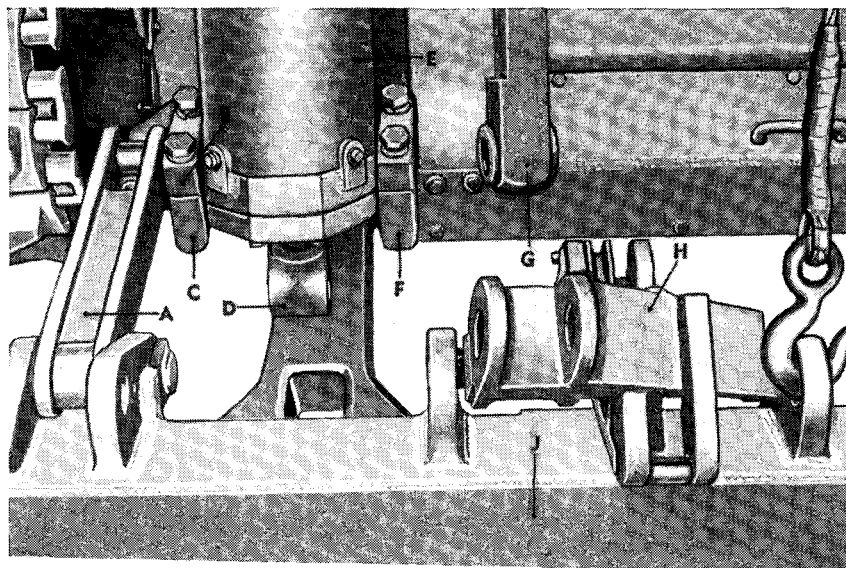


Figure 17. Connecting right-inner tilt arm to tilt-arm bracket.

k. Remove the caps from the outer halves of the two hydraulic-cylinder outer brackets. Move the two outer tilt arms backward and down to engage the free ends of the links in their respective brackets (fig. 18). Install the two caps, bolting each securely in place with the two bolts and washers.

Note. Be sure to install the caps on the proper brackets and in the proper positions, as indicated by the numbers cast in the faces of the brackets and caps.

l. Put a crowbar through the eye of one of the hydraulic-cylinder rams, and have two operators at the ends of the bar push the cylinder



A—RIGHT OUTER TILT ARM
 B—CYLINDER OUTER
 BRACKET INNER CAP
 C—CYLINDER OUTER BRACKET
 D—CYLINDER RAM EYE
 E—RIGHT HYDRAULIC CYLINDER

F—CYLINDER INNER BRACKET
 G—RIGHT INNER
 TILT ARM BRACKET
 H—RIGHT INNER TILT ARM
 J—MOLDBOARD

RA PD 124086A

Figure 18. Connecting right-outer tilt arm to right-hydraulic-cylinder outer bracket.

ram down until it almost touches the push beam. Remove the crow-bar.

m. Have an operator hold the handle at the top of the guard over this hydraulic cylinder to pull the top of the cylinder away from the vehicle until the ram end swings down into the opening at the center of the push beam.

n. Using the hoist, jockey the moldboard, while the operator holding the guard continues to pull the top of the cylinder back and forth until the eye of the ram is properly aligned with the pin holes in the push beam. Install the pin which connects the ram to the push beam, inserting this pin from the outside toward the inside through the opening in the outer side of the push beam (fig. 19).

Note. The slotted end of the pin is on the side facing the center line of the vehicle, and the pin is secured in place by a pin lock bolted to the push beam and fitted into the slot.

Place the pin lock, (M, fig. 49) in the pin slot (W, fig. 49) and secure it to the push beam with a bolt and lock washer.

Note. The surface against which this wedge is bolted can be reached through the opening at the inner side of the push beam.

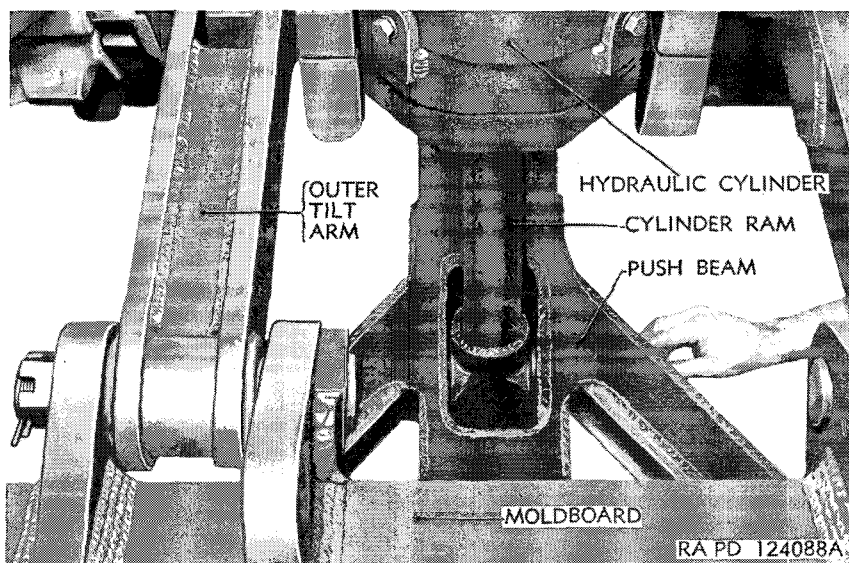


Figure 19. Connecting left-hydraulic-cylinder ram to left push beam.

- o.* Secure the ram of the other hydraulic cylinder to its push beam, in the same manner.
- p.* Securely tighten the caps of the two hydraulic-cylinder inner brackets and the caps on the inner sides of the two outer brackets.
- q.* Remove the hoist from the moldboard.

19. Removal of Interfering Parts From the Interior of the Vehicle

Note. The following instructions pertain to the installation of bulldozer components inside the vehicle. All procedures can be carried out with the turret and 90-mm gun mounted on the vehicle—and it is recommended that the turret be left on the vehicle unless equipment is on hand for its removal and installation. Removing the turret, however, will greatly facilitate the work inside the vehicle, and will reduce the total number of hours required for this installation.

- a.* Remove the cal. .30 machine gun (fig. 20) from the bow mount in front of the assistant-driver's seat by first loosening the wing nut and removing the traveling lock; then remove front locking pin and lift out gun. Remove all mount parts, cutting away those parts welded to front and top of the hull (fig. 20).

Note. The cal. .30 machine gun will not be reinstalled.

- b.* Cut away the driver's and assistant-driver's hand grips from the top of the hull (B and E, fig. 20).

Note. The grips will not be reinstalled.

- c.* Cut away the cal. .30 ammunition rack that is located on the wall in the front of the driver's seat.

Note. The rack will not be reinstalled.

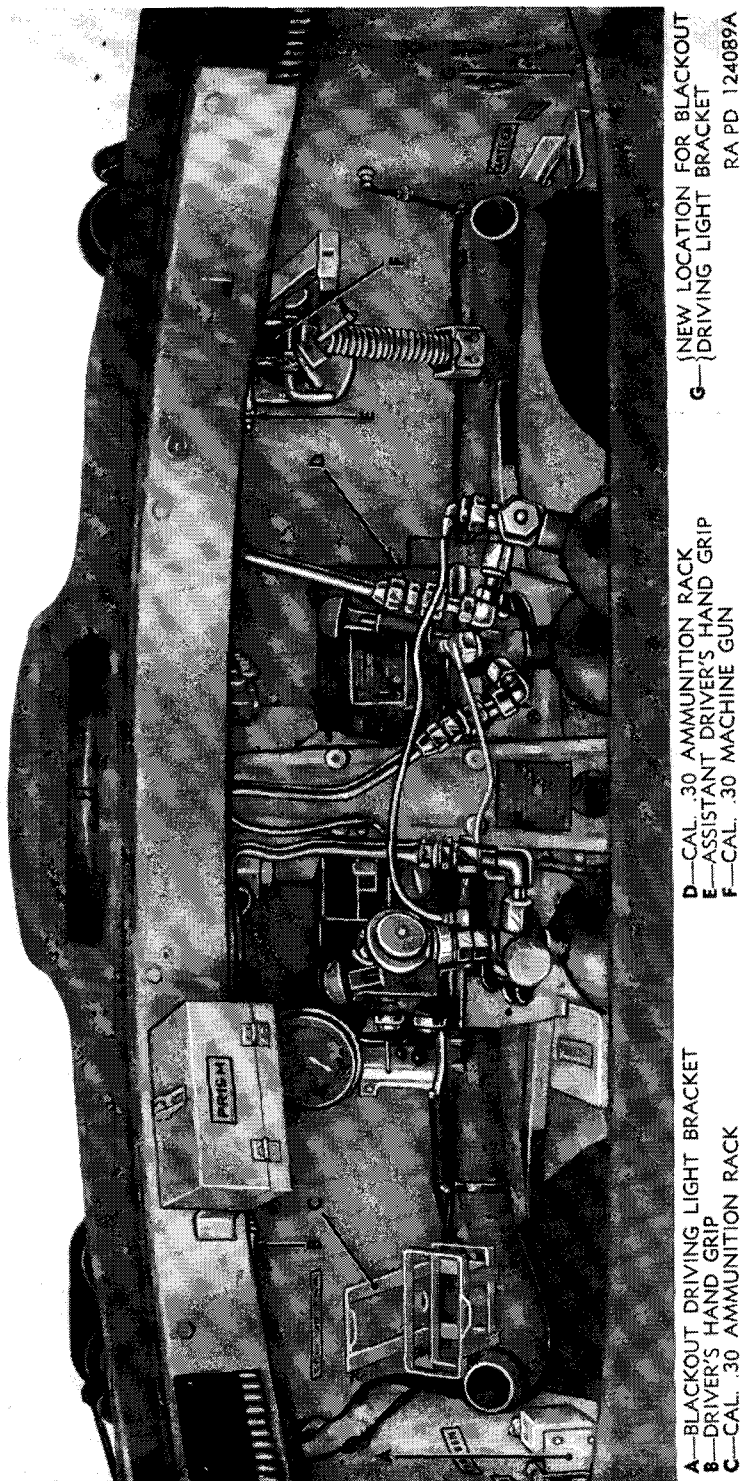


Figure 20. Parts to be removed from inside front wall of vehicle.

d. Cut away the cal. .30 ammunition rack that is located on the front wall to the left of the assistant driver's seat (C, fig. 20).

Note. The rack will not be reinstalled.

e. Cut away the blackout-driving-light bracket from the wall to the left of the driver (fig. 20).

Note. The bracket will be installed later in a new location.

f. Cut away the two cal. .30 ammunition racks from the front side of the front bulkhead which is directly in back of the driver (fig. 21).

Note. The racks will not be reinstalled.

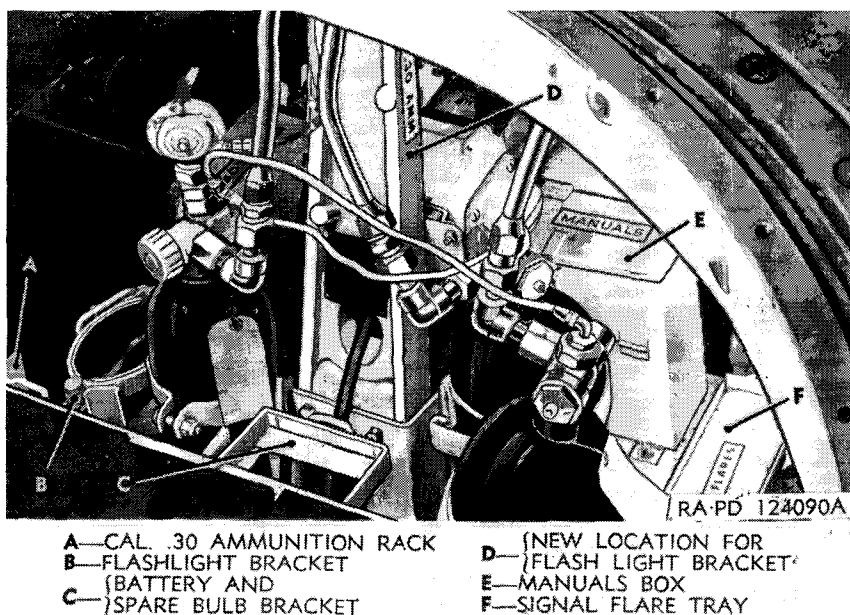


Figure 21. Parts to be removed from drivers' compartment.

g. Cut away the battery and spare-bulb bracket, and also the flashlight bracket, from the front of the front bulkhead located directly behind the driver. These are located at approximately the center of the bulkhead.

Note. Both brackets will be installed later in new locations.

h. Remove the manuals box and the signal-flare tray (fig. 21) from the mounting plate at the left of the assistant driver. These are tack welded to the plate and can be removed with a cold chisel.

Note. Both parts will be installed later in a new location.

i. Remove that section of left-rear floor panel directly in front of the engine left air cleaner (fig. 22). Remove the cal. .30 ammunition box located under this plate, and also remove the air cleaner (fig. 22).

Note. The cal. .30 ammunition box will not be reinstalled, but the air cleaner and the section of floor plate will be installed following installation of the bulldozer components.

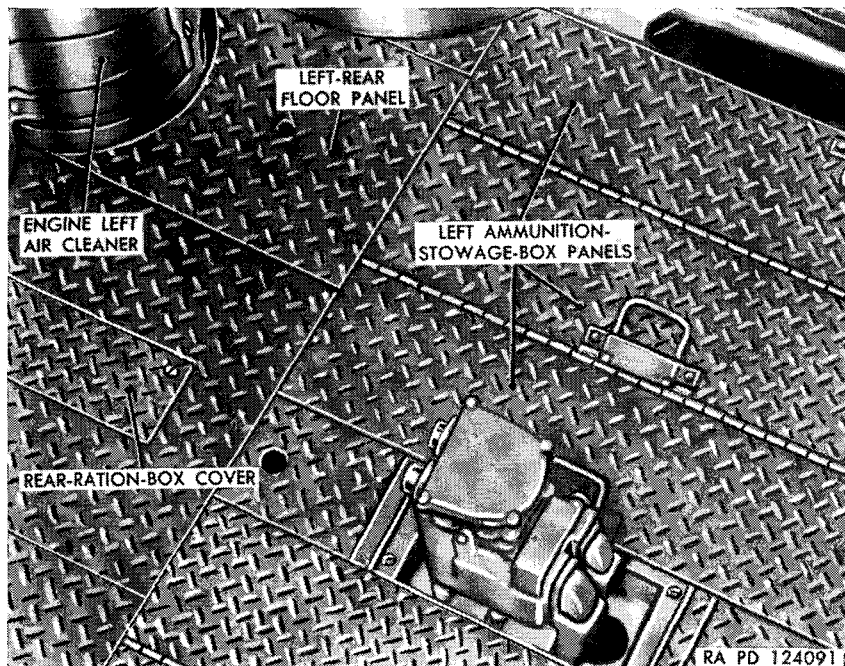


Figure 22. Parts to be removed from turret compartment.

j. Remove the ammunition-stowage-box plates on the left side of the turret (fig. 22), and remove all the 90-mm ammunition racks on this side, except the rack against the left side of the hull.

Note. The racks and plates will not be reinstalled.

k. Remove the rear ration-box cover, located directly behind the slip-ring box, and remove the rear ration box (fig. 22).

Note. The box will not be reinstalled, but the cover will be installed later.

l. Remove the ammunition compartment panel located on the left side of hull in order to install hydraulic-pump-reservoir mounting plate (par. 22).

Note. The panel will be installed later in same location.

20. Preparation of Left-Ammunition-Stowage-Box Panels, Bulkheads, and Floor Braces

a. Remove the left-ammunition-stowage-box panel (fig. 22) and lay out on the left face of the panel, the outline of an opening to be cut as shown in figure 23.

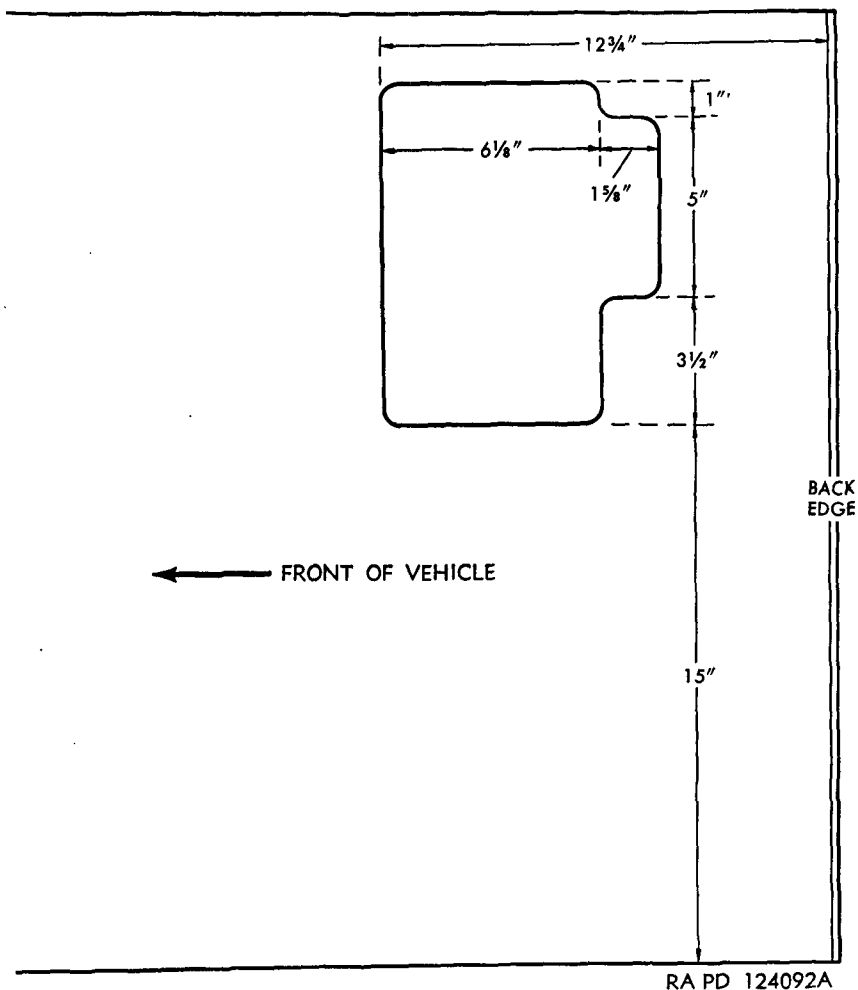


Figure 23. Location of opening to be cut in left-ammunition-stowage-box panel.

b. Cut the opening in the panel with a torch, smoothing off the sides as much as possible.

c. Install the left ammunition-stowage-box panel in the vehicle.

d. Place a ruler horizontally across the back of the column that is between the driver's and assistant-driver's seats, and make a mark to indicate the midpoint of the column. Move the ruler horizontally

down and make a second mark on the column. Draw a line joining the two points to establish the vertical center line of the column. Extend the line down to the base of the column and make it heavy enough to be clearly visible (fig. 24).

e. Position one end of the ruler against the base of the column with one side in alinement with the vertical center line and with the ruler laid flat so that the front end is supported against the column and the rear end is supported by the turret floor plate directly behind the column (fig. 24). If properly positioned, the edge of the ruler which is in alinement with the vertical center line of the column will touch the floor plate at the exact center of the vehicle, and will represent a portion of the center line of the vehicle.

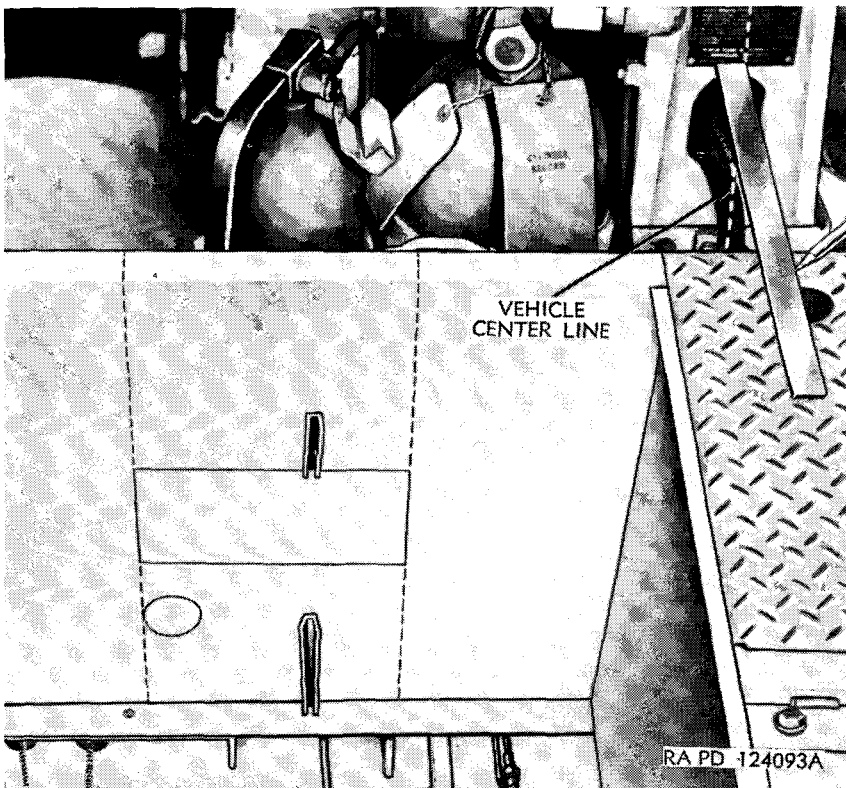


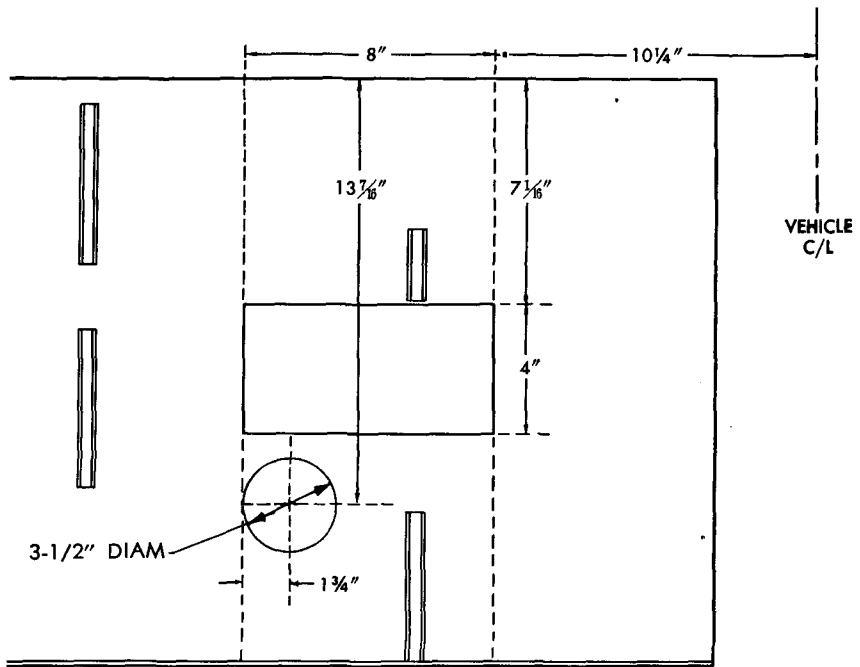
Figure 24. Locating center line of vehicle.

f. Draw a short line to represent the center line of the vehicle where it crosses the top of the front bulkhead behind the driver's and assistant-driver's seats.

g. Using the vehicle center line as a guide, lay out an opening to be cut through the front bulkhead (fig. 25).

h Using a torch, cut the opening in the front bulkhead, smoothing off the edges as much as possible.

i Lay out a circular hole to be cut in the front bulkhead below the opening just cut (fig. 25).



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Figure 25. Locations of openings to be cut in front bulkhead.

j. Cut a $3\frac{1}{2}$ -inch-diameter hole, using either a hole saw and electric drill, or a torch. If a torch is used, make the hole as nearly circular as possible, and smooth off the edges.

Note. If the vehicle already has holes cut in the rear bulkhead and hull bottom, steps k through o are not necessary. If the vehicle does not have the holes proceed with k through o.

k. In a and c above, the vehicle center line (fig. 24) was located at a point where it crosses the top of the front bulkhead. Extend this center line to the rear and make a mark where it crosses the rear bulkhead.

l. From the top of this rear bulkhead at the point where the center line of the vehicle crosses the bulkhead, measure vertically down a distance of $6\frac{7}{16}$ inches and make a mark. If correctly located, this point will be on the exact center line of the vehicle and directly in front of the center of the accessory-power-take-off shaft of the engine.

m. Using a hole saw and electric drill, or a torch, cut a $3\frac{1}{2}$ -inch-diameter hole through the rear bulkhead with the center at the point marked. If a torch is used, make the hole as nearly circular as possible, and smooth off the edges.

n. Find the point that is exactly halfway between the left wall of the vehicle and the left ammunition-stowage-box panel (*a* above). This point should also be exactly 6 inches in back of the front bulkhead.

o. Using a torch, cut a 4-inch diameter circular hole through the bottom of the vehicle, with its center at the point located, and smooth off the sides of the hole.

p. On left-front bulkhead panel lay out a rectangular opening, $3 \times 11\frac{3}{4}$ inches, a distance of $28\frac{1}{2}$ inches from vehicle center line to vertical center line of proposed opening, and a vertical distance of 4 inches from top of panel to top of opening.

q. Using a torch, cut out the opening in left-front bulkhead panel and smooth off edges.

Note. All the openings and holes referred to in this paragraph, except the $3\frac{1}{2}$ -inch diameter hole in the rear bulkhead, are shown in figure 31.

21. Installation of Hydraulic-Pump Propeller Shaft

Note. The hydraulic pump, hydraulic-pump gear drive, hydraulic-pump propeller shaft, and the gear-drive support are shipped assembled in a group (fig. 5).

a. Remove four cap screws and lock washers and disconnect the propeller shaft from the gear drive at the universal joint which is at the gear-drive end of the propeller shaft.

b. Remove four cap screws and lock washers and disconnect the propeller shaft from the flange secured to the universal joint at the other rear end of the propeller shaft.

Note. The work now to be done must be accomplished in the space between the front of the engine and the rear bulkhead (which separates the engine compartment from the turret). This space is very limited. The work must be performed by reaching back through the $3\frac{1}{2}$ -inch diameter hole cut in the rear bulkhead, and by reaching around behind the bulkhead through the opening left by the removal of the engine left air cleaner. It is suggested that two operators be used for most of this work; one operator seated in the well left by the removal of the air cleaner and the floor cover plate that was in front of it; the other operator located on top of the turret floor plates at the right rear of the turret. The first operator can reach behind the front bulkhead through the air-cleaner opening with one hand to hold wrenches in place. He will remove the parts which have been loosened by second operator and lift out parts. The second operator, reaching down through the access opening to fuel tank selector valves and through the $3\frac{1}{2}$ -inch-diameter hole in the rear bulkhead, can use the wrenches and position parts into place (fig. 26). One man can do the job alone if his arms are long enough.



Figure 26. Position of operator for removing parts from accessory-power-take-off shaft.

c. Disconnect the fuel line which connects the vehicle fuel tank with the inner fuel pump, breaking the line at the quick-disconnect connector which is located at the left side of the fuel pump (fig. 27). Place the end of the line down, away from the cover over the engine accessory-power-take-off shaft. If the quick-disconnect connector is pressed up close against the cover, rotate the 45-degree elbow which fastens the connector to the fuel pump, so that the end of the connector will be far enough away from the accessory-power-take-off cover to permit easy removal of the cover.

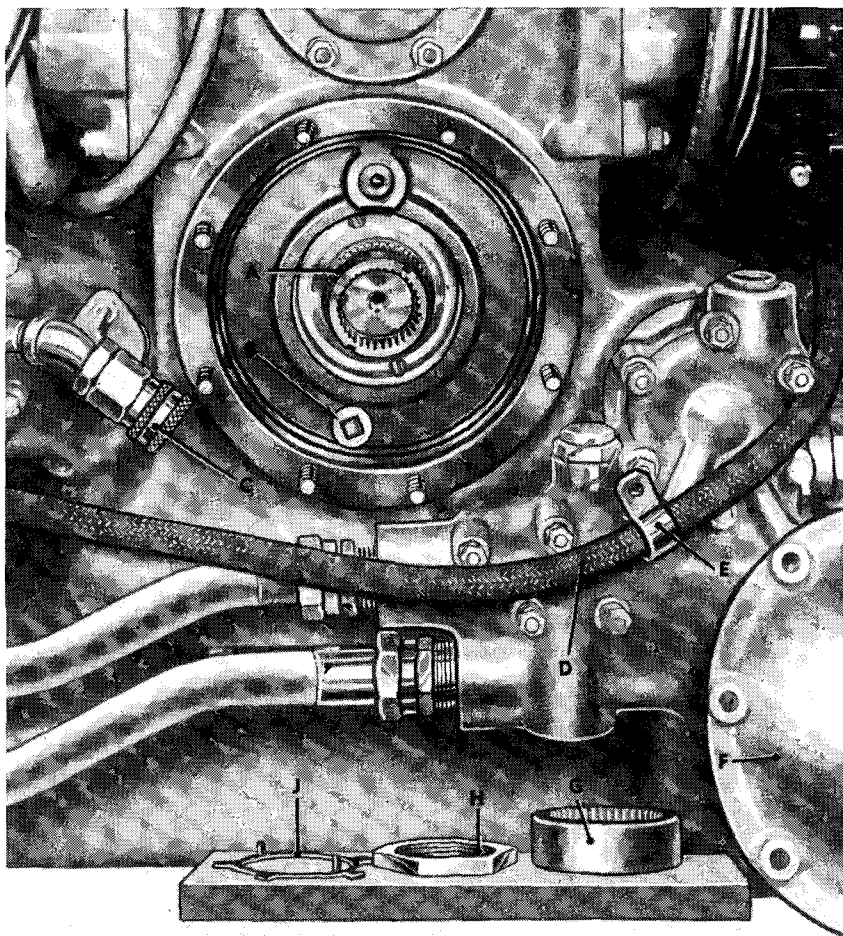
d. Remove fuel-line clip, located on the fuel line between the inner fuel pump and carburetor. Push the fuel line down as far as possible to provide easy access to the accessory-power-take-off cover.

e. Remove eight nuts and washers and remove the accessory-power-take-off cover, which is located at the front of the vehicle engine.

Note. When the cover is removed a small amount of engine oil, trapped in the space behind the cover, will spill out.

f. Remove the large hex nut and lock washer which are on the end of the accessory-power-takeoff shaft, and remove the spacer which was held in place by this nut.

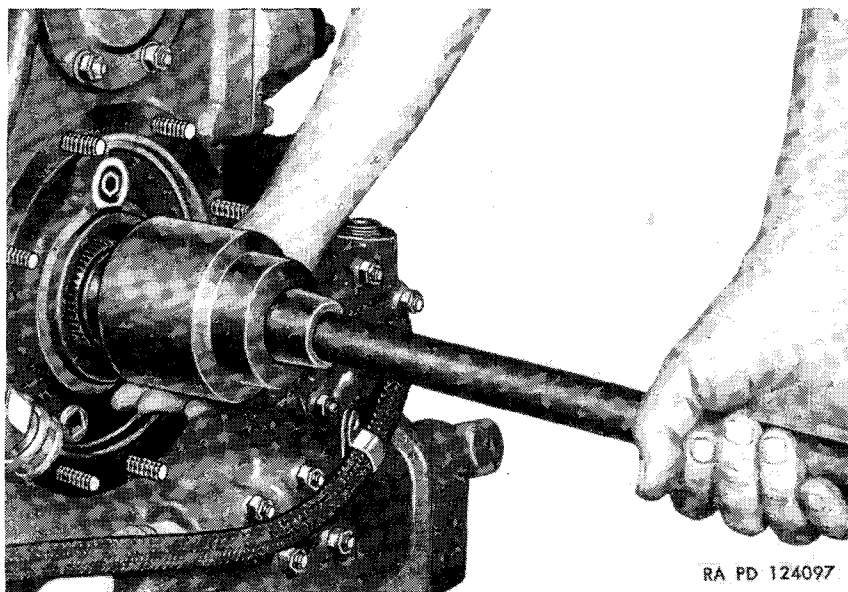
Note. To remove the nut, use a 2½-inch socket wrench with a 15-inch adapter (fig. 28), which will give sufficient length to the tool for it to extend forward through the opening in the bulkhead.



- A—ACCESSORY POWER TAKE OFF SHAFT
- B—COUNTERSUNK PIPE PLUG
- C—QUICK DISCONNECT CONNECTOR
- D—FUEL LINE
- E—FUEL LINE CLIP
- F—ACCESSORY POWER TAKE OFF COVER
- G—ACCESSORY POWER TAKE OFF SHAFT SPACER
- H—ACCESSORY POWER TAKE OFF SHAFT NUT
- J—ACCESSORY POWER TAKE OFF SHAFT LOCK WASHER

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Figure 27. Parts to be removed from engine-accessory-power-take-off shaft.



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Figure 28. Removing power-take-off-shaft nut.

g. Install the oil seal (shipped tied to the end of the propeller shaft) around the exposed accessory-power-take-off shaft, in the place formerly occupied by the spacer. Install the seal with the spring, which is at one side of the seal, facing the engine.

Note. One method of installing this seal is to start it squarely over the shaft by hand then tap around the shaft, using the 2½-inch socket wrench and adapter used for removal of the nut. One operator can hold the socket against the seal, while the other operator taps the seal in place.

h. Install the pipe plug (shipped tied to the end of the propeller shaft) in the threaded opening which is almost directly below the end of the accessory-power-take-off shaft inside the area that was enclosed by the cover.

Note. This opening was provided for oil circulation, and the plug is necessary to close the drain-back opening.

i. Remove the eight bolts and lock washers and separate the two parts of the flange that was removed (b above) from the end of the propeller shaft.

j. Install the rear part of the flange (the part with the female spline fitting) over the end of the accessory-power-take-off shaft, pushing it back onto the shaft as far as possible.

k. Install the lock washer and large hex nut removed in f above.

l. Install the remaining part of the flange onto the part which is now attached to the engine, securing it in place with eight bolts and lock washers.

m. Lower the propeller shaft through the opening left by removal of the rear ration box, and push the back end of the shaft out through the hole in the rear bulkhead to mate with the universal joint at the end of the flange now attached to the engine. Attach the universal joint to the flange with four cap screws and lock washers (fig. 29).

Note. The propeller shaft can be positioned by lowering the front end (end disconnected from the hydraulic-pump gear drive) into the opening first, and pushing it forward under the floor plates far enough to drop the back end of the shaft through the opening.

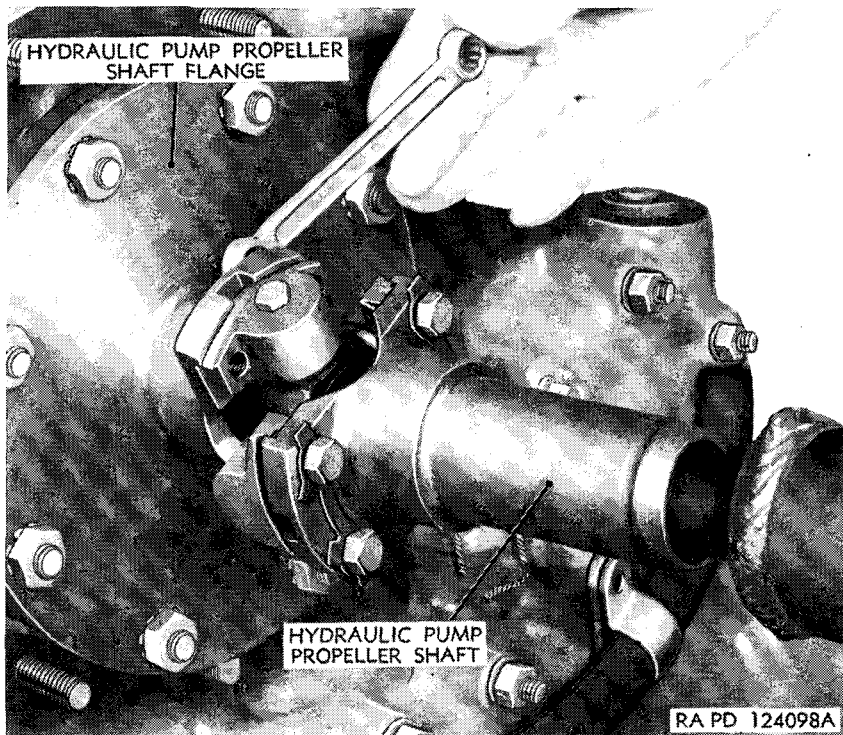


Figure 29. Installing hydraulic-pump-propeller shaft to accessory-power-take-off shaft.

22. Installation of Hydraulic-Pump-Reservoir Mounting Plate

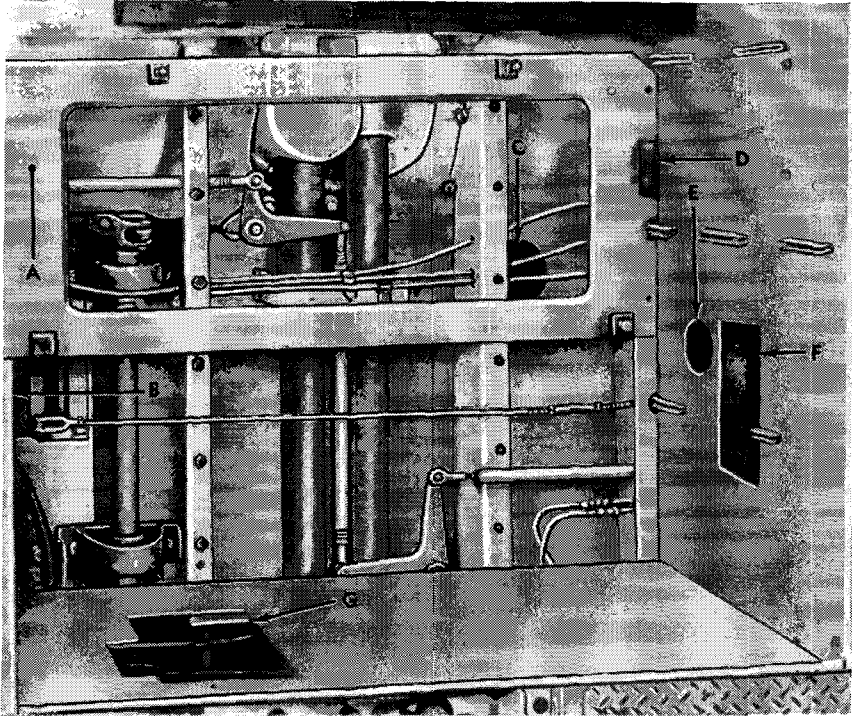
Note. The hydraulic-pump-reservoir is shipped with the mounting plate and mounting-plate support secured to it.

a. Remove four bolts and lock washers and separate the reservoir from the reservoir mounting plate.

b. Position the reservoir mounting plate in the bottom of the open space formed by removal of the 90-mm ammunition racks, placing it as close as possible to the left wall of the vehicle with the mounting-

plate support (bolted to the underside of the mounting plate) at the rear, up against the rear bulkhead (fig. 30).

Note. The mounting plate will lie across the tops of the three vehicle floor supports located in the open space, with the front edge resting on the vehicle floor support at the front of the space. The front edge has a small oblong-shaped opening to fit around one of the brackets welded to the front bulkhead, this bracket having been used to support one of the panels which were removed with the 90-mm ammunition racks (fig. 30).



- A—HYDRAULIC PUMP RESERVOIR MOUNTING PLATE
- B—MOUNTING PLATE SUPPORT
- C—HOLE IN VEHICLE FLOOR FOR HYDRAULIC PUMP RESERVOIR DRAIN
- D—OBLONG SHAPED OPENING IN FRONT EDGE OF MOUNTING PLATE
- E—(HOLE IN FRONT BULKHEAD FOR HYDRAULIC PUMP
- F—)CONTROL VALVE CONTROL LINKAGE
- G—OPENING IN FRONT BULKHEAD FOR INTERIOR HYDRAULIC LINES
- H—(OPENING IN LEFT AMMUNITION STOWAGE BOX PANEL
- I—)FOR HYDRAULIC PUMP GEAR DRIVE

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Figure 30. Hydraulic-pump-reservoir mounting plate.

c. Make certain that the mounting-plate support at the rear of the reservoir mounting plate is pressed firmly against the rear bulkhead, and that the mounting plate is level, then tack weld the mounting-plate support to the rear bulkhead at several points.

d. Punch mark the centers of two holes to be drilled for two mounting bolts to be located at the two front corners of the mounting plate.

Note. These holes will be drilled through the top of the vehicle floor support which is just in back of the front bulkhead.

e. Remove the mounting plate and drill two $1\frac{3}{32}$ -inch-diameter holes with centers at the positions marked.

f. Weld the mounting-plate support to the rear bulkhead with a $\frac{1}{4}$ -inch weld all along the bottom edge and both ends, and with tack welds spaced approximately every 6 inches along the top edge.

Note. Make certain that the tack welds will not interfere with mounting of the reservoir mounting plate or the hydraulic-pump-gear drive support to be installed later (par. 23).

g. Again install the mounting plate and secure it in place with two bolts, nuts, and lock washers at front and two bolts and lock washers at the rear.

23. Installation of Hydraulic-Pump Gear Drive and Hydraulic Pump

Note. The hydraulic pump is shipped mounted to the hydraulic-pump gear drive (V, fig. 5); and the gear drive is mounted to the gear-drive support. Two right-angle-male-adaptor unions are installed in the pump, one in the outlet port at top, the other in the inlet port at bottom.

a. Remove four nuts and washers and separate the gear drive from the gear-drive support.

b. Remove six nuts and lock washers and separate the hydraulic pump from the hydraulic-pump-gear-drive case.

Note. The gear drive can be installed with the pump attached, but is more easily handled with the pump removed.

c. Lower the gear-drive support into place in the vehicle. When properly positioned, the free end of the support will rest on top of the mounting-plate support just installed (par. 22), and the other (front) end of the support will rest on top of the floor support that is in front of the mounting-plate support.

d. Secure the gear-drive support to the mounting-plate support with two bolts and washers.

e. Punch mark the centers of the two holes which must be drilled in the floor support under the front end of the gear-drive support.

Note. In some vehicles, the hole provided in the gear-drive support at the left side will fall directly above a cut-away portion of the floor support, so that it will be impossible to use a mounting bolt at this position. In such case, punch mark an alternate hole to be drilled through the gear-drive support and the floor support at a point as far to the left on the gear-drive support as possible. In some vehicles it may also be necessary to knock away an oblong-shaped mount-

ing plate that is tack welded to the underside of the floor support under the mounting hole at the right side of the gear-drive support.

f. Remove the gear-drive support and drill two $\frac{13}{32}$ -inch-diameter holes at the points just marked.

g. Position the gear-drive support and secure it to the floor support (fig. 31) with two bolts, nuts, and lock washers, and to the mounting-plate support with two bolts and lock washers.

h. Position the gear drive on the support and secure it with four nuts and washers removed (a above).

Note. The unsupported high side of the gear-drive case will project through the opening cut in the left-ammunition-stowage-box panel (fig. 31).

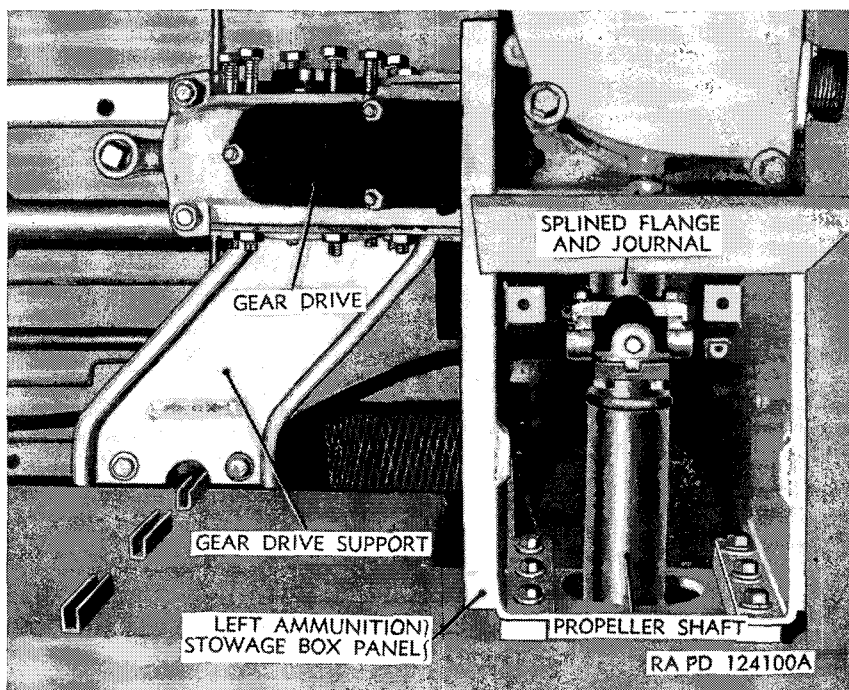


Figure 31. Hydraulic-pump gear drive installed.

i. Attach the spider on the hydraulic-pump propeller shaft to the splined flange on the gear drive with four cap screws and lock washers.

j. Position the hydraulic pump in place on the gear drive and secure it with the six nuts and lock washers removed (b above).

Note. When properly installed, the off-center mounting flange of the pump will allow the pump assembly to project to the left, away from the panel to the left of it. The inlet port of the pump will be at bottom and the outlet port will be at top. Set the adapter union at the bottom so that it points at approximately a 45-degree angle to the left rear, and set the adapter union at the top to point at approximately a 15-degree angle to the left front.

24. Installation of Hydraulic-Pump Reservoir and Control Valve

Note. The hydraulic-pump reservoir is shipped with the control valve mounted on the right side, a rubber hose and right-angle-male-adaptor union installed in the top of the control valve, the inlet fittings and filler cap installed at the rear of the reservoir right side, a 45-degree-adaptor union and rubber hose installed near the bottom on the right side, and a drain outlet installed in the bottom near the front (fig. 32).

a. Remove the hydraulic-pump-to-reservoir rubber hose installed at the right side of the reservoir.

Note. If the turret is removed from the vehicle, the reservoir can be installed with all the remaining parts attached. Otherwise, remove parts as instructed in *b* through *d*.

b. Remove four cap screws and lock washers and remove the control valve and gasket from the reservoir.

c. Remove the inlet fittings and filler cap in one piece from the reservoir.

d. Remove four cap screws and lock washers, and remove the drain-outlet assembly from the reservoir. Remove the 45-degree-adaptor union to which the hydraulic-pump-to-reservoir hose was attached.

e. Install the hydraulic-pump-to-reservoir hose to the hydraulic pump, connecting it at the adaptor union on the under side of the pump.

Note. This is the hose removed from the reservoir (*a* above).

f. Lower the reservoir onto the mounting plate, alining the lugs at the bottom of the reservoir with the mounting pads welded to the top of the plate.

Note. The reservoir is positioned with the control valve on the right side at front. If the turret has not been removed from the vehicle, position the turret so that the 90-mm gun is pointing 90-degrees right (TM 9-718), then lower the reservoir through the hatch, using a cable tied to the strap handle welded onto the front end of the reservoir. When lowering the reservoir through the hatch, jockey it so that the lugs welded to the sides will pass through. Have two operators inside the vehicle to handle the reservoir as it is lowered through the hatch. When the reservoir is completely inside the turret, place it in the approximate mounting position; but before lowering it completely, install the drain-outlet assembly and the 45-degree-adaptor union removed (*d* above). Do not bolt the reservoir in place at this time.

g. Connect the hydraulic-pump-to-reservoir hose to the 45-degree-adaptor union installed in the reservoir.

Note. In order to start the hose in the union it will be necessary to have the reservoir farther back than its mounting position on the mounting plate, and the reservoir must be pushed forward on the mounting plate as the union is tightened on the hose.

h. Secure the reservoir to the four mounting pads on the mounting plate with four bolts and lock washers.

i. Remove the filler cap, gasket, and filler-cap adapter from the pipe straight elbow that is installed at one end of the pipe nipple which was removed from the reservoir.

Note. These parts were removed as an assembly (c above).

Install the pipe in the reservoir with the elbow attached, tightening it so that the elbow points straight up. Install the filler-cap adapter, gasket, and filler cap in the elbow.

j. Position the control valve on the mounting pad at the right side of the reservoir at front, placing the gasket between the valve and the mounting pad. Secure the valve in place with four cap screws and lock washers.

Note. The valve is positioned with the adapter union and hose (still connected to valve) at top, pointing toward the rear. This is the control-valve-to-hydraulic-pump hose.

k. Connect the free end of the control-valve-to-hydraulic-pump hose to the adapter union installed in the top of the hydraulic pump (fig. 32).

Note. Installation of this hose can be greatly facilitated by removing the adapter union from the top of the hydraulic pump and by installing in its place a 1 x 1½-inch close nipple. Connect the male end of the union to the free end of the hose, using a 1 x 1½-inch straight union. The female end of the adapter union can now easily be connected to the nipple installed in the hydraulic pump.

25. Installation of Control-Valve Operating Lever

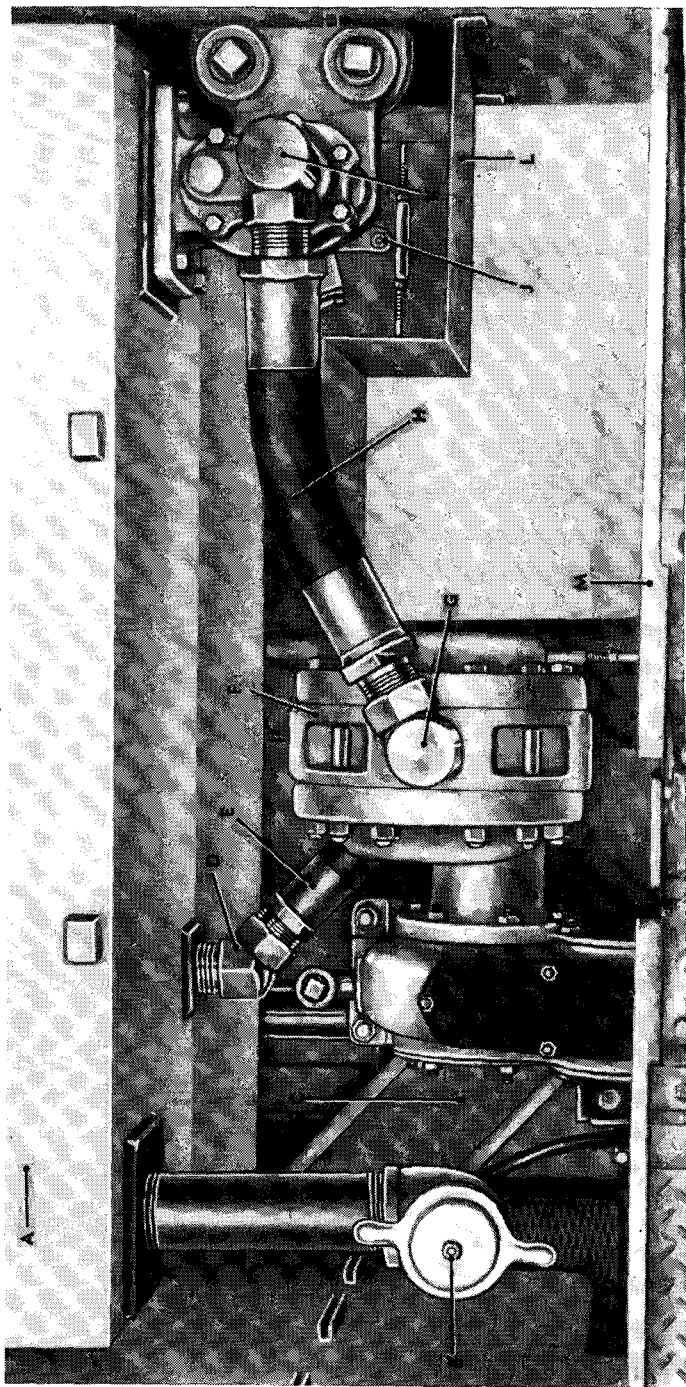
Note. The control-valve operating lever, connecting links, supports, and mounting pads are shipped as a group (fig. 5). The links consist of a front (long) rod with rod-end eyes at each end; one shaft having a yoke bolted to each end; and a rear (short) rod with rod-end eyes at each end.

a. Attach the rear (short) rod to the control valve by passing one end of this rod back through the opening cut in the front bulkhead, and connecting the eye at the end of the rod to the valve-stem-head link (fig. 32), using the bolt, nut, and lock washer that are attached to the rod-end eye.

b. Fasten the yoke at one end of the shaft to the rod-end eye at the free end of the rear (short) rod, using the bolt that is in the yoke to engage the rod-end eye (fig. 33).

c. Position the shaft and supports parallel to the front bulkhead bottom edge.

d. Each of the two supports is secured to a mounting pad. Push the right support and pad as far to the right on the shaft as possible, with the rear end of the pad resting on top of the vehicle floor support that is directly behind the driver's seat. With the rear (short) rod (connected to the control valve) parallel to the center line of the



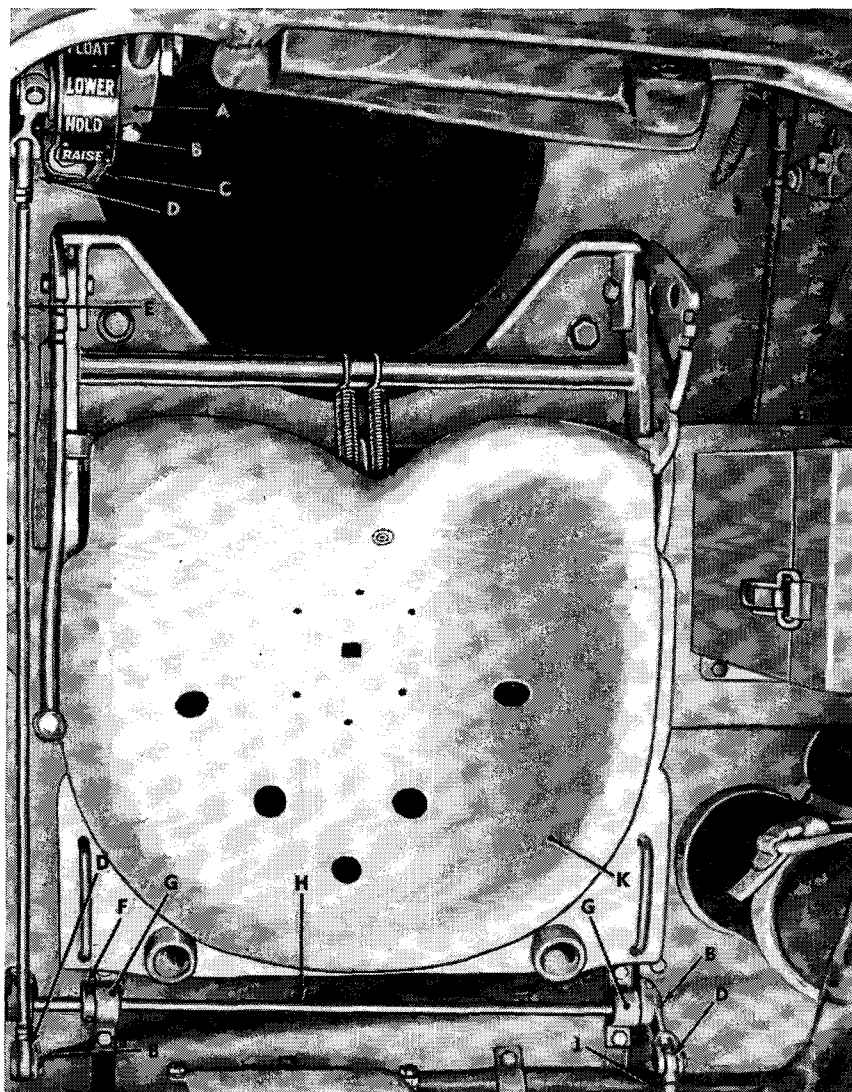
- A—HYDRAULIC PUMP OIL RESERVOIR
 B—RESERVOIR FILLER CAP
 C—GEAR DRIVE SUPPORT
 D—ADAPTER UNION
 E—CONTROL VALVE TO HYDRAULIC PUMP HOSE
 F—HYDRAULIC PUMP
 G—MALE ADAPTER UNION
 H—VALVE STEM HEAD LINK
 J—VALVE STEM HEAD LINK
 K—HYDRAULIC PUMP CONTROL VALVE
 L—SPARE RATION BOX
 M—LEFT AMMUNITION STOWAGE BOX PANEL

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Figure 32. Hydraulic pump, oil reservoir, and control valve installed.

vehicle, position the shaft 5 inches in front of the front bulkhead and tack weld the right mounting pad to the vehicle floor support.

e. Position the left support pad approximately 2 inches from the left end of the shaft with the pad horizontal and the rear end resting against the vehicle floor in a position in which it will hold this support



- | | |
|---------------------------------|-------------------------------|
| A—CONTROL VALVE OPERATING LEVER | F—COLLAR |
| B—CONTROL VALVE CONTROL YOKE | G—SHAFT SUPPORT |
| C—LEVER MOUNTING BRACKET | H—CONTROL VALVE CONTROL SHAFT |
| D—CONTROL ROD END EYE | J—REAR CONTROL ROD |
| E—FRONT CONTROL ROD | K—DRIVER'S SEAT |

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Figure 33. Control-valve control linkage.

at the same height as the first support. Check to make certain that the shaft is parallel to the front bulkhead bottom edge. Tack weld this support to the floor at several points.

f. Remove two bolts and lock washers from each support and slide the two supports away from the two mounting pads. Secure each pad to the vehicle with a $\frac{1}{4}$ -inch weld all the way around.

g. Slide both supports along the shaft until they are over their respective pads and secure each in place with two bolts and lock washers.

h. Attach one end of the front (long) rod to the control-valve-shaft yoke at the left end of the shaft, using the bolt in the yoke to secure the rod-end eye that is at the end of the front (long) rod.

i. Loosen the set screw of the collar that is at the left end of the shaft (to the left of the support at this end), push the collar to the right against the side of the support, and retighten the set screw in the collar.

j. Attach the free end of the front (long) rod to the control-valve operating lever by bolting the rod-end eye at this end of the rod to the yoke.

k. Position the valve-stem-head link at its extreme rear (float) position, and move the operating lever to "FLOAT."

l. Place the operating-lever assembly against the left wall of the vehicle, and check to see that the linkage is free from obstruction. Check to see that the lever can be conveniently operated by the driver.

Note. The assembly can be moved forward or backward along the wall (to obtain clearance for the linkage and maximum convenience of operation for the driver) by adjusting one or more of the two rod-end eyes on the front (long) rod and the two rod-end eyes on the rear (short) rod.

m. Tack weld the operating-lever mounting bracket to the vehicle wall and recheck location as in *l* above. If satisfactory, weld the mounting bracket to the wall with a $\frac{1}{4}$ -inch weld all around.

26. Installation of Interior Hydraulic Lines

Note. The four lines used to connect the control valve with the exterior hydraulic lines are shipped, with fittings attached, together with mounting clamps and blocks. When installing lines and fittings, use mica-base antiseize compound on all threads, being careful not to get compound inside the lines or fittings.

a. Install one 90-degree pipe elbow in the right port at the front of the control valve, and another one in the left port. Install the elbows so that the one at the right will point horizontally to the right, and the one at the left will point at approximately a 45-degree angle to the right and up.

Note. There are six ports in that portion of the control valve which projects forward through the opening in the front bulkhead. Four of these ports are already closed with plugs. Check to make certain that all plugs are tight.

b. Select the shortest of the four lines, and connect the bent end of this line to the 90-degree elbow installed in the right port of the control valve.

c. Select the longest of the three remaining lines, and connect that end of the line having the sharpest bend to the free end of the line already installed.

d. Connect the free end of the last line installed (c above) to the 90-degree hose union which is at the upper (free) end of that hose which is the left one of the two hoses at the front of the vehicle.

Note. To make this last connection, the free end of the line must be inserted through the cal. .30 machine gun port. The hose to which it is to be connected is connected at the lower end to the hydraulic line which connects the top of the right hydraulic cylinder to the top of the left cylinder. The line can be connected to the hose with the hydraulic-piping upper guard already installed on the outside.

e. Select the shorter one of the two remaining lines, and connect the bent end to the 90-degree elbow mounted in the left port of the control valve.

f. Connect that end of the remaining line which has the most angular bend to the free end of the last line installed.

g. Connect the free end of the last line installed to the 90-degree hose union at the top (free) end of the remaining one of the two hoses on the outside of the vehicle.

h. Take one of the two hydraulic line clamps and mounting blocks shipped with the lines, remove the bolt and lock washer and remove the clamp from the mounting block. Reassemble the clamp to the block around the two lines which extend along the right wall of the vehicle, adjacent to the assistant-driver's seat. Slide the clamp and block to approximately the midway point of these lines, and weld the mounting block to the vehicle wall with a $\frac{1}{8}$ -inch weld all the way around. Tighten the bolt to draw the clamp tightly around the lines.

i. In the same manner, install the remaining clamp and mounting block on the two lines which extend laterally along the front of the front bulkhead. Slide this clamp and block to the approximate midway point of the lines, and weld the mounting block to the bulkhead with a $\frac{1}{8}$ -inch weld all the way around. Tighten the bolt to draw the clamp tightly around the lines.

27. Check Operation of Hydraulic System

a. Remove the hydraulic-pump-reservoir filler cap (fig. 32) and fill the reservoir with hydraulic oil (OHA). The total capacity of the hydraulic system is approximately 28 gallons.

Note. The hydraulic system will operate satisfactorily with as little as 20 gallons of hydraulic oil in the reservoir.

b. Start the vehicle engine (TM 9-718) and operate the control-valve operating lever (fig. 33) to test moldboard operation.

Note. Moldboard will be raised when operating lever is placed at "RAISE;" will be lowered when the operating lever is placed at "LOWER."

There is a spring-loaded ball in the operating-lever which drops into detents in the operating-lever bracket when the lever is in the "HOLD" and "FLOAT" positions. This ball acts as a lock for the lever in these positions, and considerable force is required to move the lever when the ball is in a detent. There is also a knurled thumb screw on the lever which, when released, drops into a hole in the bracket when the lever is in the "FLOAT" position and locks the lever in this position. The lever cannot be moved until this thumb screw is withdrawn from the hole. A quarter turn of the screw will hold it in the open position.

c. With the moldboard partially raised, move the operating lever to "HOLD" (fig. 33). The moldboard should remain stationary for any desired length of time. If it does not remain stationary, but slowly settles to the ground, service the hydraulic-pump control valve (par. 59g).

d. Move the operating lever to "FLOAT." The moldboard should now slowly settle to the ground.

e. Repeat the preceding operations to make certain that the hydraulic system is operating properly.

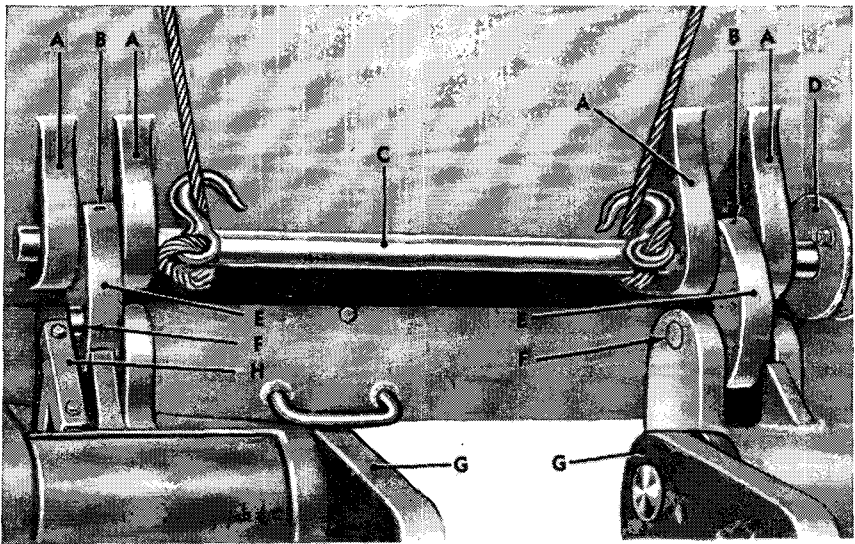
28. Installation of Carrying Hooks

Note. The carrying-hooks shaft assembly (fig. 5) is shipped with the mounting brackets on the shaft, the carrying-hooks cable attached to the shaft drum, two cable brackets either tied or strapped to the cable, and the operating-lever assembly attached to the other end of the cable.

a. Remove the bolt, washer, and cable-drum block from the cable drum at the end of the carrying-hooks shaft and unwind the cable from the drum.

b. Position the complete shaft assembly—with the carrying hooks and mounting brackets on the shaft—at the rear of the moldboard with the drum end of the shaft at the left, the shaft parallel to the front of the vehicle and ground, and with each carrying hook engaged with its pin (fig. 34).

Note. The two carrying-hook-engagement pins are located on the top of the respective inner tilt arms. Each pin is retained by two brackets welded to the tilt arm and to the pin so that the pin assembly forms a U-shaped latch with which the associated carrying hook can easily be engaged or disengaged by rotation of the carrying-hooks shaft.



A—BRACKET
B—SET SCREW
C—CARRYING HOOKS SHAFT
D—CABLE DRUM

E—CARRYING HOOK
F—ENGAGEMENT PIN
G—INNER TILT ARM
H—EMERGENCY LIFT CABLE GUARD

RA PD 124103A

Figure 34. Installing carrying-hooks shaft.

c. Tie the ends of two ropes or cables to the carrying-hooks shaft, one near each end just inside the brackets at the end, then place two operators on top of the vehicle to hold the ends of these ropes.

Note. The ropes will be used to pull the carrying-hooks-shaft assembly upward on the front of the hull to locate it at the proper height.

d. Start the vehicle engine (TM 9-718), and place the control-valve operating lever at "RAISE" so that the moldboard is lifted up to its highest position, then move the operating lever to "HOLD." While the moldboard is being lifted, have the two operators holding the ropes (tied to the carrying-hooks shaft) pull the shaft up to keep it from being jammed between the moldboard linkage and the hull.

Note. When the moldboard has reached its highest position, the carrying-hooks-engagement pins on the tilt arms will either touch or will very nearly touch the vehicle at points just above the hydraulic-piping lower guard. At this point, the carrying-hooks shaft should be suspended directly above the engagement pins with the back sides of the carrying-hooks-shaft brackets pressed against the vehicle hull.

e. Holding the brackets against the vehicle hull, position the shaft so that it is exactly horizontal and in such a position so that rotation of the shaft will easily disengage and engage the carrying hooks with their engagement pins. Tack weld the brackets to the hull at several points on each bracket.

f. Remove the ropes from the carrying-hooks shaft and rotate the shaft by hand to make certain that the hooks are engaging and disengaging properly. Lower the moldboard to the ground. Securely weld each of the carrying-hooks-shaft brackets to the hull with a $\frac{1}{2}$ -inch weld all the way around each bracket.

Note. Be careful not to move the brackets while welding. During the welding process, it is advisable to occasionally rotate the shaft manually to make certain that it is not being bound by distortion of the brackets.

g. Remove the carrying-hooks operating lever and cable-drum block from the drum to which this shaft is attached, and remove the carrying-hooks cable from the drum. Remove the two sheave brackets from around the cable, and untie the carrying-hooks-cable end from the cable.

h. Hold the end of the cable to which the turnbuckle (fig. 53) is attached approximately 2 feet above the drum at the end of the carrying-hooks shaft. Wind the cable one and one-half turns around the drum, then secure the cable to the drum by bolting the cable-drum block (removed in *a* above) to the cable drum (fig. 36) with the bolt and washer.

Note. When inserting bolt into drum, put it between the two wrappings of the cable.

i. Lay the long end of the cable vertically across the front of the vehicle so that the line formed by the cable is at a right angle to the carrying hooks shaft (fig. 36).

Note. The end of the cable will reach back to the verticle turret (if turret is on vehicle), and cable should be grasped at about the point where it strikes the base of the turret and stretched tight to trace a straight line upward along the vehicle hull.

Measure back down along the cable, from the point at which it touches the rim of the vehicle turret well, a distance of 10 inches and make a mark on the turret hull.

Note. This mark will now be in direct alinement with the cable drum on the carrying-hooks shaft, and will be on the flat top-front portion of the hull just to the right of the driver's hatch.

j. Cut a $2\frac{3}{4}$ -inch-diameter circular hole through the hull, centered at the point marked, and smooth off the edges.

k. Hold the cable-lower-sheave bracket (that contains the drum from which the operating lever has been removed) with the drum at the bottom, and insert the circular sleeve (that is at the top of the bracket) up into the hole just cut (fig. 35). Rotate the bracket until the axis of the drum is parallel to the axis of the carrying-hooks shaft, and the small bracket (attached to one side of the larger bracket) is at the right. Tack weld the bracket to the inside of the hull at several points.

l. Check to make certain that the bracket is properly positioned, then securely weld the bracket to the inside of the hull with a $\frac{1}{8}$ -inch weld all the way around (fig. 35).

m. Hold the larger cable-upper-sheave bracket removed from the cable (the one having a circular mounting flange at one end) above the hole cut in the hull, with the flange at back and the axis of the pulleys parallel to the axis of the carrying-hooks shaft. Thread the long end of the cable into the front opening of this upper bracket, over one of the sheaves, and down and out through the bottom opening at the back of the bracket. Continue threading the cable down through the hole in the vehicle hull, in back of that inside sheave (mounted in the lower bracket inside the hull) which is on the same

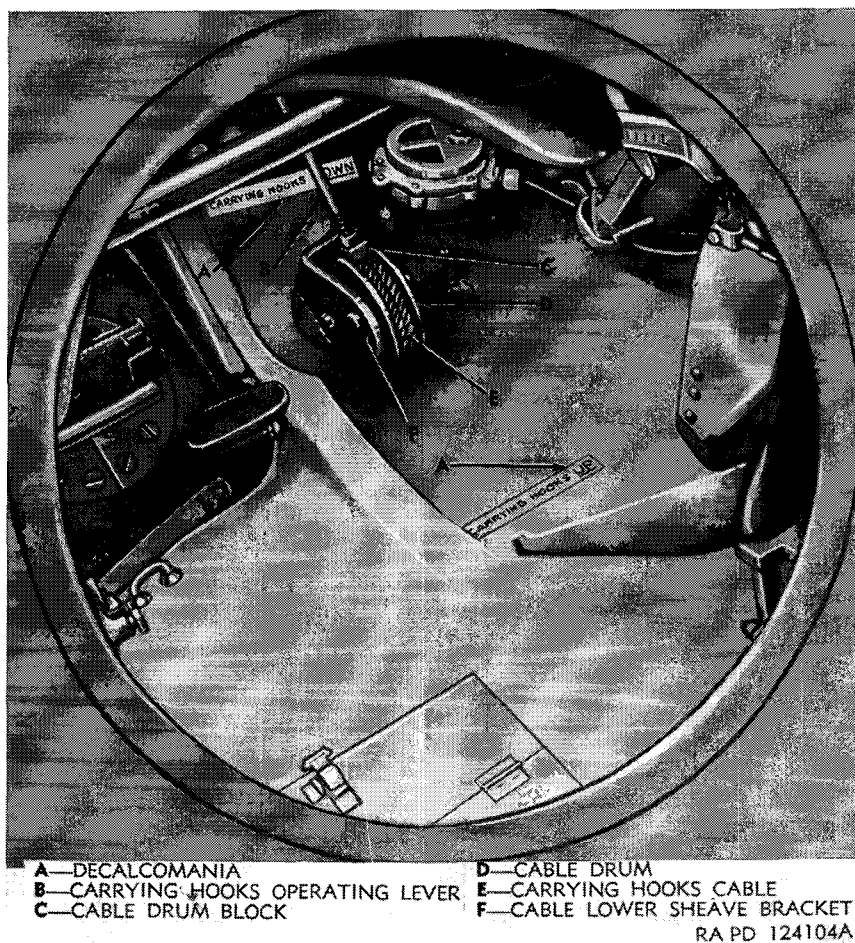


Figure 35. Carrying-hooks operating lever and cable-lower-sheave bracket.

side with the exterior sheave over which the cable has been threaded. Pull the cable down around the drum at the bottom of the lower bracket. Wrap the cable two full turns around this drum, then thread the end back up through the bracket in back of the second inside sheave, and out through the hole cut in the vehicle. Continue threading the cable up through the opening in the bottom of the upper bracket, over the top of the second sheave in this bracket, and out the front of the bracket. Pull the cable tight.

n. Lower the upper bracket onto the vehicle hull, centering the hole in the rear over the hole cut in the hull, and keeping the sheave axis parallel with the carrying-hooks shaft axis. Tack weld the flange at the back of the bracket to the hull at several points.

o. Check to make certain that the bracket is properly mounted so that the cable can move through it freely over all of the bracket sheaves, then securely weld the bracket to the hull with a $\frac{1}{8}$ -inch weld all around the exposed perimeter of the flange at the back of the bracket.

p. Wrap the plain end of the cable with wire for a distance of one-fourth inch, in two places located approximately one-half inch and 3 inches from the cable end.

q. Disassemble the carrying-hooks-cable-end connector (which was tied to the cable) by unscrewing the cable-end sleeve out of the clevis part, and removing the pointed plug.

r. Push the sleeve, plain end first, over the cable end far enough to prevent the cable from fanning out, then remove the first wire wrap. Insert a screwdriver blade into the center of the cable strands to spread them, pry out the hemp center, then cut the hemp center off just above the second wire wrap.

s. Push the cable-end sleeve down over the cable far enough to insert the pointed plug, point first, among the cable strands. Alternately tap the sleeve and the plug to drive them onto the cable until the lower end of the sleeve is approximately $2\frac{3}{8}$ inches from the end of the cable. Drive the plug in so that it seats solidly. Compress the protruding cable strands and screw the clevis part tightly back onto the cable-end sleeve (fig. 36).

t. Open the carrying-hooks-cable turnbuckle at the other end of the cable so that the cable will be slack, then secure the free cable end to the turnbuckle with a cap screw and nut.

u. Take the smaller (remaining) cable-guide-sheave bracket and place it against the front of the vehicle hull, under the two strands of the cable, at a point approximately 30 inches above the center line of the carrying-hooks shaft. Position this bracket so that the axis of the two sheaves is parallel to the carrying-hooks shaft, and with the

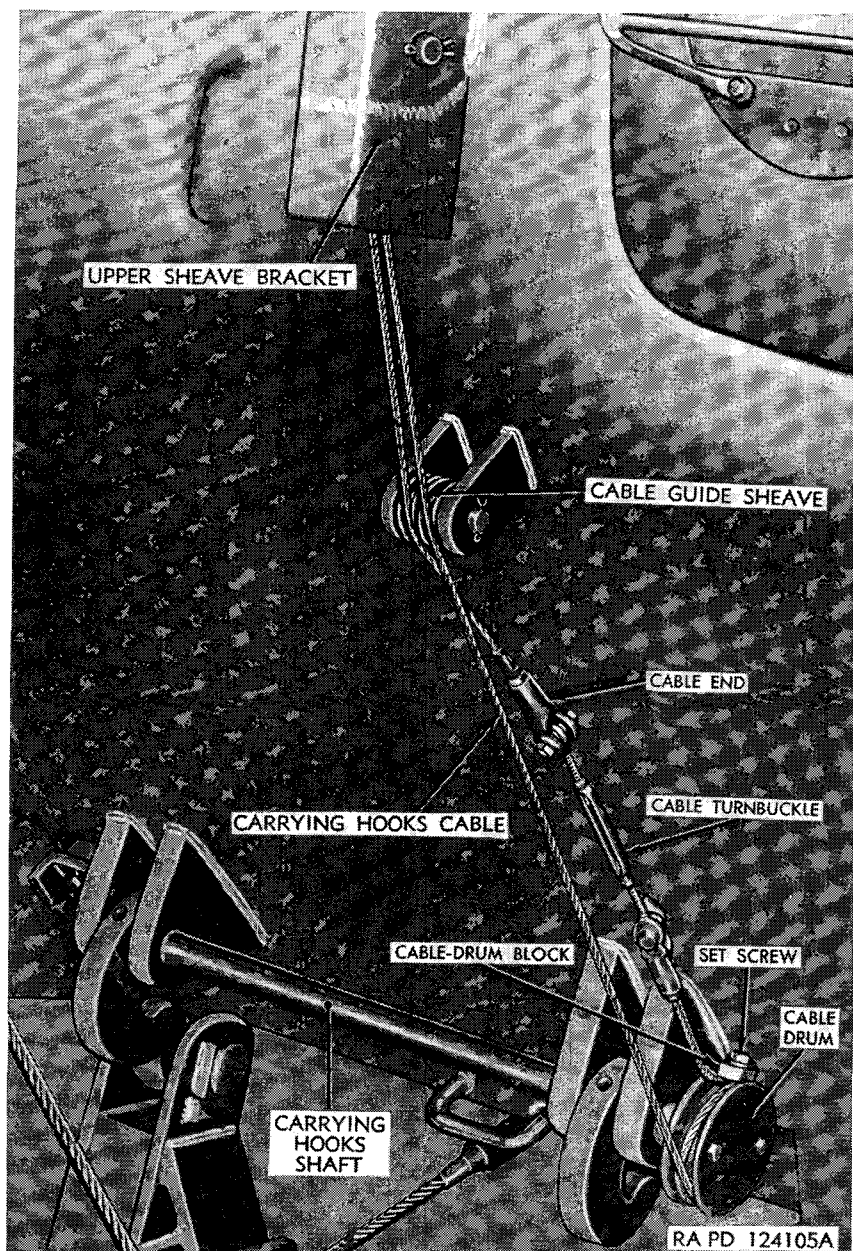


Figure 36. Carrying-hooks cable installed.

two strands of the cable seated in the sheaves. Tack weld the two bracket parts to the hull at several points.

Note. The purpose of this bracket is to hold the carrying-hooks cable out from the hull so that it will not scrape the hull at any point.

Check bracket alinement, and securely weld both parts of the bracket to the hull with a $\frac{1}{8}$ -inch weld all around.

v. Rotate the carrying-hooks shaft to place the carrying hooks up. The rear of hooks will touch vehicle hull and the cable-drum block should also approximately touch the hull at the top of the drum.

Note. If cable-drum block is incorrectly positioned, loosen set screws in both carrying hooks, position drum and hooks correctly, then retighten set screws.

Install the cable-drum block on the drum inside the vehicle and install the carrying-hooks operating lever (with nut on end of lever) in the drum by inserting the threaded end of the lever into the drum between the two strands of cable (fig. 35).

Note. Do not tighten the nut down against the block at this time.

Without moving the cable, rotate the drum to move the knob end of the operating lever as far forward as it will go.

Note. Drum can be slipped inside of cable loops.

w. Take all slack out of the cable by drawing the turnbuckle up tight. Secure it by tightening the lock nuts at each end of the turnbuckle.

x. With the carrying-hooks shaft and the operating lever both positioned as already explained (*v* above), tighten the nut on the operating lever to force the cable-drum block up against the cable and hold it securely to the drum in this position.

y. Install the "CARRYING HOOKS UP" decalcomania on the inside of the vehicle hull just in front of the most forward position to which the carrying-hooks operating lever can be moved (fig. 35), arranging it so that it is readily readable by the driver. Install the "CARRYING HOOKS DOWN" decalcomania on the inside of the vehicle hull at the most backward position to which the lever can be moved (fig. 35).

Note. These decalcomanias are shipped in a sack tied to the hydraulic pump reservoir. Their positions, as indicated, place them over the driver's head.

29. Installation of the Emergency-Lift Hand-Operated Pump

Note. The hand-operated pump is shipped as a unit with two mounting blocks bolted to the base of the pump, and the hose which connects this pump with the hydraulic jack already installed in the pump.

a. Position the pump assembly, with mounting blocks attached, on the subfloor to the left of the assistant-driver's seat (fig. 37). Locate the pump as close to the assistant-driver's seat as possible, and in such a position that the assistant-driver can easily operate it by moving the operating lever with his left hand.

Note. The front of the pump is the side to which the hose is attached.

b. Tack weld each of the two pump mounting blocks to the vehicle at several points.

c. Remove two bolts and lock washers from each mounting block (four bolts and lock washers in all) and remove the pump from the blocks.

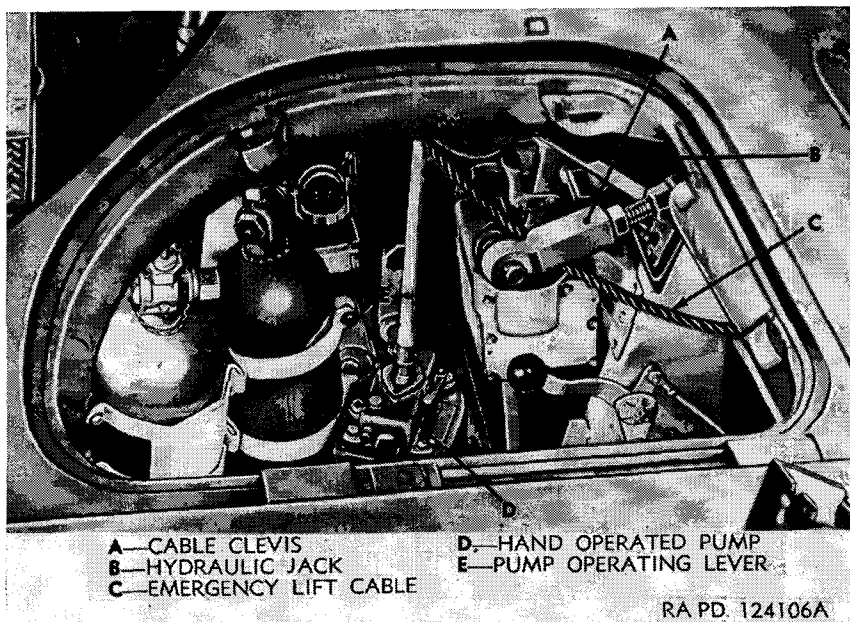


Figure 37. Emergency-lift hand-operated pump and emergency-lift hydraulic jack.

d. Securely weld the two blocks to the vehicle using a $\frac{1}{4}$ -inch weld all the way around.

e. Position the pump on the mounting blocks and secure with the four bolts and lock washers.

30. Installation of Emergency-Lift Hydraulic Jack

Note. The hydraulic jack (fig. 5) is shipped complete with the emergency-lift cable and all mounting supports for the emergency-lift cable.

a. Unwind the cable and remove all parts tied to or hanging onto cable. Remove the cap screw, lock washer, and pin that secure the

cable-end connector to the inner-sheave support, and remove the emergency-lift cable.

b. Remove the cap screw, lock washer, and pin which secure the hydraulic jack to the inner-sheave support, and remove the jack.

c. Temporarily attach the plain end of the cable to the inner side of the right push beam, tying or wiring the cable end through the eye of the boss that projects from the front end of the push beam at this side.

Note. In order to drop the cable end straight down to the point of attachment on the push beam, thread it through the opening in the right inner tilt arm (H, fig. 18) which is just to the right of the cable-guard bracket which will be installed (par. 31) on top of this tilt arm (fig. 34).

d. Lay the cable back across the front of the vehicle hull so that it will trace a straight line (on the hull) which will be at a right angle to the carrying-hooks shaft, and so that the upper end of the cable will cross the flat portion of the hull on a line directly in back of, and above, the point at which the cable is tied to the push beam.

Note. The object is to locate a hole on the flat portion of the hull through which the cable can enter into the vehicle so that a straight backward pull on the cable will lift the moldboard.

e. Trace the outline of the cable onto the flat portion of the vehicle hull, making a mark at each side of that portion of the cable which touches this portion of the hull.

Note. The center of this cable outline should be approximately 46 inches to the right of the vehicle front-to-rear center line.

f. Hold the inner-sheave support against the inside of the hull top, under the lines just drawn so that the axis of the sheave in support is at a right angle to the lines, and the sheave is centered with respect to the lines.

Note. When properly positioned, the flat surface of this support is on top, against the hull, and the projecting portion of the support is at the front. The front edge of this projecting portion is shaped to conform with the interior contour of the hull, at the angle between the flat top and sloping face of the hull (fig. 35).

g. Push the support as far forward as it will go (until the forward edge of the support touches the sloping front of the hull). Pull the support straight back again to separate the front edge of the support from the front of the hull by a distance of approximately one-fourth inch.

Note. When properly positioned, the back of the support will be just in front of the rim of the vehicle-turret well.

h. Measure the distance between the closest point on the rim of the turret well and the center of the sheave axis in the support.

Note. This distance can be accurately measured by holding a straightedge at the round end of the pin which supports the sheave in the support, so that the

straight edge will touch the under side of the support flange at a point directly above the center of the pin, and by then measuring the horizontal distance between this point and the edge of the rim.

i. Draw a line around the edge of the support flange, so that the support can be relocated in this exact same position.

j. On top of the hull, at a point midway between the two lines drawn to trace the cable outline on the hull, measure forward from the rim a distance equal to the distance measured in *h* above, and make a mark.

Note. This mark will then be directly above the exact center point of the sheave axis.

Now measure forward from this point a distance of $1\frac{1}{16}$ inches, and make a second mark.

k. Using the second mark made in *j* above as center, cut a $3\frac{7}{8}$ -inch-diameter hole in the top of the hull.

Note. Hole must be a minimum of $3\frac{7}{8}$ inches in diameter and must not exceed $4\frac{1}{4}$ inches in diameter. Edges must be smooth.

Again position the inner-sheave support on the inside of the vehicle according to the outline made in *i* above, and securely weld the support in place with a $\frac{1}{4}$ -inch weld all around the edges of the flange.

l. Position the jack in the support, insert the pin through the jack-ram eye and secure the pin to the support with a cap screw and lock washer.

Note. When the jack is properly mounted, the hose coupling at the top of the jack is on the left side.

m. Position the two-piece clamp around the jack and secure the clamp to the two mounting blocks with a bolt and lock washer in each block. Position the clamp so that the free ends of the two blocks will rest squarely against the front of the vehicle hull when the jack is swung forward. Also position the clamp so that it is approximately 2 inches above the lower end of the jack cylinder. Tighten the bolts to hold the clamp in this position.

Note. When clamp is properly positioned, the jack can be swung forward until the ends of the mounting blocks touch the vehicle hull without interference.

n. Swing the jack forward until the mounting blocks touch the vehicle hull and tack weld both blocks to the hull.

o. Remove the two bolts and lock washers and remove the clamp from the jack, then finish welding the two blocks to the hull with a $\frac{1}{4}$ -inch weld all the way around each block.

p. Position the jack in the clamp and secure the clamp to the mounting blocks with the two bolts and lock washers.

Note. If properly mounted, the jack will be positioned straight forward against the inside face of the sloping front of the vehicle hull, and there will

be ample clearance for the bottom edge of the sheave bracket at the end of the jack piston, when the piston is fully extended.

g. Connect the free end of the hose, that is already attached to the hand-operated pump, to the hydraulic jack at the hose coupling installed at the upper-left side of the jack. Tighten all fittings in this hydraulic line, but be careful not to twist the hose.

31. Installation of Emergency-Lift Cable

a. Untie the cable from the push beam.

b. Attach the cable-end connector (fig. 37) to the inner-sheave support by installing the cable-connector pin and securing it to the support with a cap screw and lock washer.

c. Pass the free end of the cable downward in front of the jack, backward around the sheave at the bottom end of the jack piston (between the sheave bracket and the sheave), upward along the back side of the jack into the bottom of the inner-sheave support, and out through the hole cut in the vehicle hull.

d. Place over the cable, the round cable guide (in which there is a hole for the cable to pass through), the cable-guide weather seal, and the large outer-sheave support (the base of which is shipped to fit the contour of the rounded top-front portion of the vehicle hull) (fig. 38).

Note. The cable is threaded through the outer-sheave support over the top of the sheave and under the cross-piece welded to the top of the support.

e. Pass the cable end downward along the front of the hull, and thread the end downward through the slot in the top of the right inner tilt arm (just to the right of the cable-guard bracket to be installed in *p* below) (fig. 34).

f. Disassemble the emergency-lift-cable clevis (shipped tied to the cable) by removing the cable-end sleeve and the grooved plug.

g. Wrap the plain end of the cable with wire for a distance of one-half inch, at each of three places approximately one-half inch, 3 inches, and 6 inches from the end.

h. Push the cable-end sleeve, plain end first, over the cable end far enough to prevent the cable from fanning out, then remove the first wire wrap. Insert a screwdriver blade into the center of the cable strands to spread them, pry out the hemp center, then cut the hemp center off just above the center wire wrap.

i. Push the cable-end sleeve down over the cable far enough to insert the grooved plug, pointed end first, among the cable strands, so that each strand lies in a groove of the plug. Alternately tap the sleeve and the plug to drive them onto the cable, until the lower end of the sleeve is approximately $3\frac{5}{16}$ inches from the end of the cable. Drive the plug in so that it seats solidly.

j. Compress the protruding cable strands and screw the clevis tightly onto the sleeve.

k. Remove the nut and pin from the clevis, then use these to attach the clevis to the projecting boss at the left side of the right push beam.

l. Draw the cable tight from inside the vehicle, and position the outer-sheave support at the top-front curvature of the hull, with the back of the support resting on top of the hull and the front of the support pressed against the sloping front of the hull (fig. 38). Aline the support sheave with the sheave in the inner-sheave support.

Note. The two sheaves must be exactly in line so that the cable can track over both in a straight line.

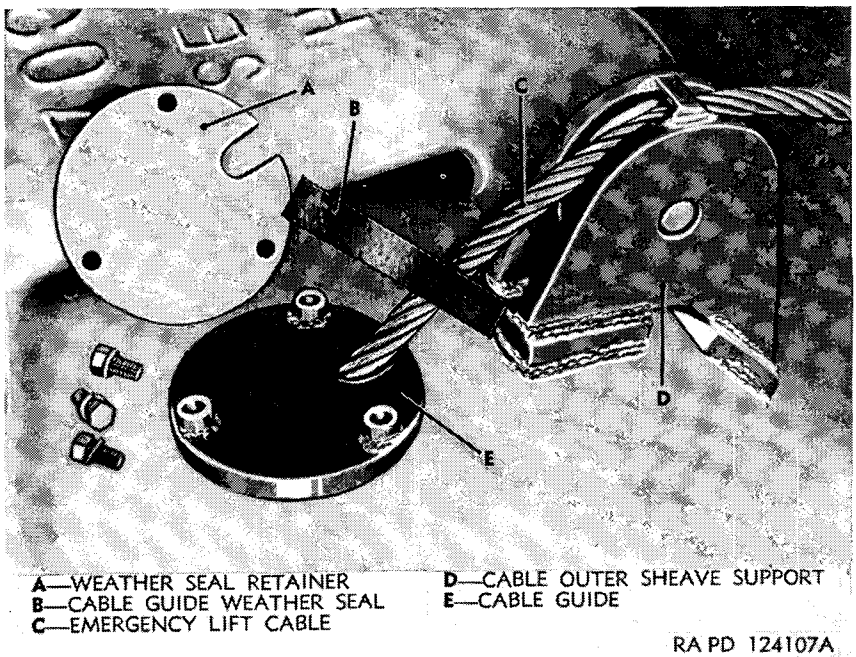


Figure 38. Emergency-lift-cable outer-sheave support and guide.

Tack weld the outer-sheave support to the hull in this position.

Note. If support is properly positioned, the cable will not only track correctly over the two sheaves, but will also pass through the hole cut in the vehicle hull without touching the hull at any point. If cable should touch hull, break the support away from the hull and shift it either forward or backward, or elevate it by shimming under it as necessary to free the cable from interference when the cable is drawn tight. Then, again tack weld it to the hull.

m. Position the weather-tight plate on the hull over the hole cut in the hull, so that it completely covers this hole, and so that the cable

will pass through the hole in the plate without interference when the cable is drawn tight.

Note. Make certain that cable will move freely through this plate.

Tack weld the plate to the hull.

n. Take the small sheave and pin (shipped tied to the cable) and mount this sheave in the brackets which project downward on the underside of the right inner tilt arm (fig. 39). The sheave should be mounted so that cable passes around it. The pin is secured to the inside bracket with a cap screw and lock washer.

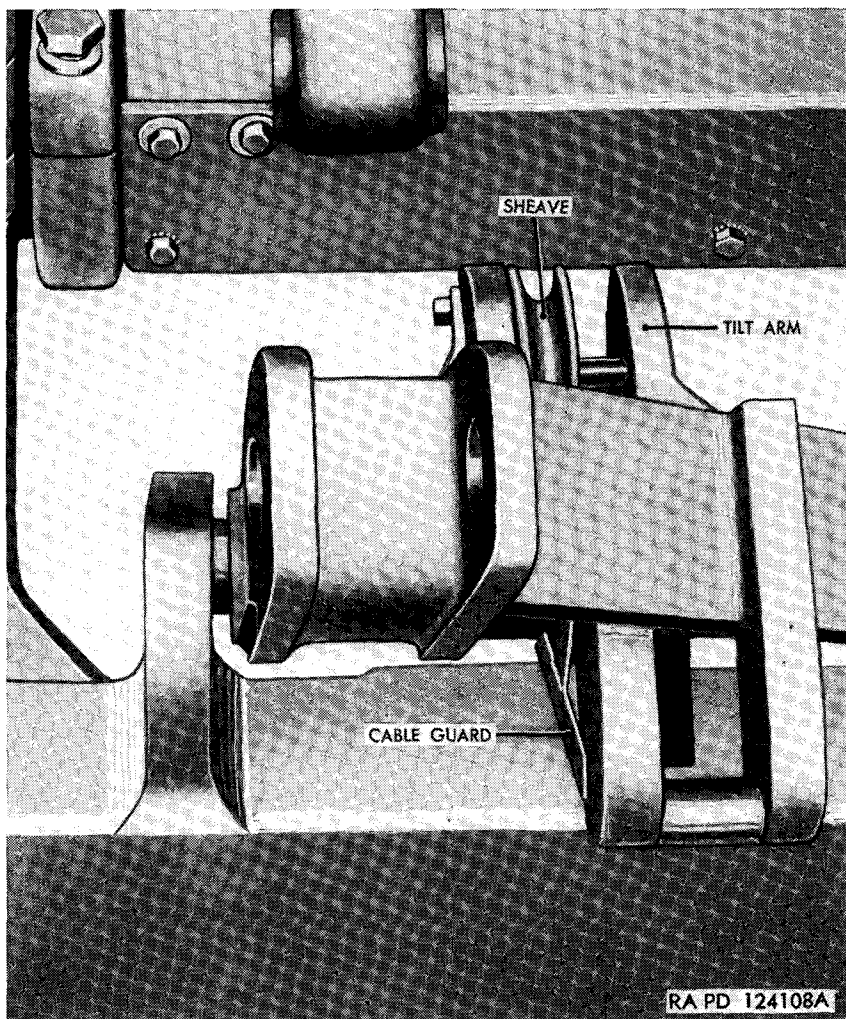


Figure 39. Right-inner tilt arm with emergency-lift-cable sheave installed.

o. Carefully check alinement of the cable end fastened to the push beam, the sheave mounted on the tilt arm, the sheave in the outer-sheave support (at the top front of the hull), and the inner sheave (inside the hull). If all are properly alined, and cable has no interference at any point, securely weld the outer-sheave support to the hull with a $\frac{1}{4}$ -inch weld all around. Securely weld the weather-tight plate to the hull with a $\frac{1}{4}$ -inch weld all around.

p. There are two mounting blocks already welded to the top side of the right inner tilt arm, one on the front of the carrying-hooks-engagement pin right bracket, the other directly in front of this, in a recess in the top of the tilt arm. Take the cable-guard bracket, which is an approximate H-shaped piece (shipped tied to the cable) and bolt it to these mounting blocks with two cap screws and lock washers (H, fig. 34, and fig. 39). When properly mounted, the guard will project down through the opening in the tilt arm at the left side of the cable, and will serve to keep the cable free from entanglement with the carrying hook at this side of the vehicle.

q. Press the weather seal (already around cable) down onto the cable guide welded to the top of the hull. Position the weather-seal retainer on the guide and secure it with three cap screws and lock washers (fig. 38). There is a slot at the front of the retainer for passage of the cable. Draw the retainer down as tightly as possible.

r. Disconnect the internal end of the cable from the inner-sheave support by removing the cap screw, lock washer, and pin which hold the cable-end connector to the support.

s. Start the vehicle engine (TM 9-718), move the control-valve-operating lever to "LOWER" until moldboard is fully lowered, then move the lever to "HOLD."

Note. Moldboard will raise front of vehicle approximately 9 inches above floor when fully lowered.

t. Pull the cable tight, with the hydraulic-jack piston all the way up in the jack cylinder, and adjust the cable-end connector so that it can be secured to the inner-sheave support without permitting any slack in the cable.

Note. Connector is adjusted by loosening the lock nut on the threaded rod and turning the clevis part up or down on the threaded rod, and by retightening the lock nut.

u. Secure the cable-end connector to the inner-sheave support with the pin, cap screw, and lock washer.

32. Filling Emergency-Lift System With Oil and Checking Operation

a. If moldboard is not fully lowered, lower it (par. 31s).

b. Remove the filler plug from the hand-operated-pump reservoir,

b. Push the box down onto the floor of the hull, press it forward against the bulkhead in front of it and also press it against the panel at the right. Punchmark the centers of two bolt holes in the bulkhead at front, and four more in the panel at right, as indicated by the bolt holes in the box.

c. Remove the box and drill six $\frac{9}{32}$ -inch diameter bolt holes.

d. Install the box and secure it in place with six bolts, nuts, and lock washers.

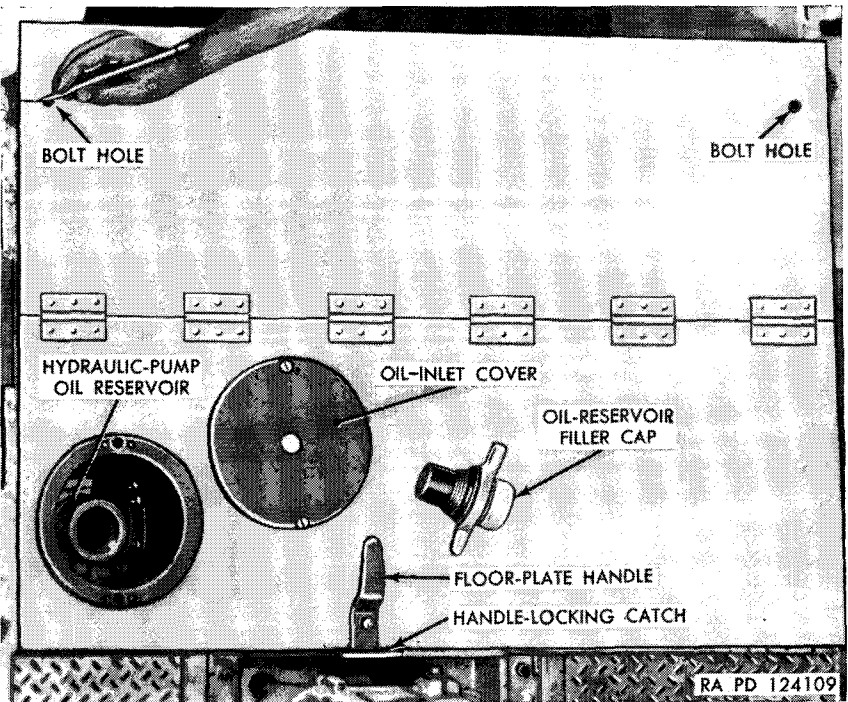


Figure 40. Locating left floor plate in turret compartment.

e. Place the hinged floor plate over the top of the space occupied by the hydraulic-pump reservoir and pump, locating the circular oil-inlet cover of the plate directly over the oil-filler cap of the reservoir (fig. 40).

Note. Edges of plate should rest on the top edges of the bulkheads at front and rear, and the panels at right and left of the space (fig. 40). The oil-inlet should be on the top side of the plate.

f. There are two bolts in the left half of the plate, one near the front edge, the other near the rear edge. From the center of each hole, draw a mark on the plate to the nearest point on the edge of the plate (lines will be parallel to left edge of plate), then make a mark

and fill the reservoir with hydraulic oil (fig. 47). Total capacity is approximately 1 gallon. Install plug.

Note. Plug is on top of reservoir at left side of pump (which is mounted on top of reservoir).

c. Move the control-valve operating lever to "FLOAT."

d. Raise the release-valve lever (on the right side of the hand-operated-pump housing) to upright position.

e. Move the hand-operated-pump operating lever steadily back and forth to pump oil into the emergency-lift jack and raise the moldboard. Raise the moldboard as high as it will go.

f. Operate the carrying-hooks operating lever to engage the carrying hooks with their pins. If the emergency-lift jack has elevated the moldboard properly, these will readily engage.

Note. Failure of hooks to engage will indicate too much slack in emergency-lift cable, with consequent failure of mechanism to lift moldboard all the way up to its extreme position. In such a case readjust cable (par. 31).

g. Disengage the carrying hooks and move the release-valve lever down (lever rotates downward toward rear of pump). The moldboard should slowly settle to the ground as oil is forced (by weight of moldboard) out of the emergency-lift jack and back into the pump reservoir.

h. Move the control-valve operating lever to "LOWER" until moldboard is again at its lowest position. Recheck the level of oil in the hand-operated-pump reservoir. Add oil (*a* above) as required to bring the lever up to the bottom of the filler plug.

Caution: Never add oil to this reservoir unless the moldboard is in the extreme lowered position, thus placing the piston of the emergency-lift jack full up in the cylinder. If reservoir should be filled while piston is partially out of its cylinder, there would be too much oil locked into this closed hydraulic system, and it would be impossible to lower the moldboard to its lowest position without damage to the emergency-lift mechanism.

i. Move the control-valve operating lever to "FLOAT," and turn off the vehicle engine (TM 9-718).

33. Installation of Spare Ration Box and Turret Left Floor Plate

Note. The spare ration box (fig. 5) is shipped as a single unit, and the hinged floor plate is shipped as an assembly with the handle, catch, mounting blocks, and two mounting pads for the "MANUALS" box tied to the plate.

a. Lower the ration box into the space in front of the hydraulic pump, between the hydraulic-pump reservoir and the left-center floor panel. The open side is to be up, and the widest portion is to be at the rear (fig. 32).

on top of each adjacent bulkhead, where the line runs into the bulkhead.

g. Remove the floor plate and measure the thickness of the plate at the edges where the marks have been made.

h. From the top of each bulkhead, where the marks were made on the bulkhead, draw a line straight down on the face of the bulkhead for approximately 1 inch, then measure one-fourth inch down along this line from the top of the bulkhead and draw a horizontal line to cross the vertical line at this point.

Note. Each horizontal line will now indicate the height at which the top of a mounting block must be located for the plate to be properly bolted to it, and each vertical line will indicate the position of the center of the hole in the mounting block. The block is made so that the hole will be the right distance out from the bulkhead when the block is installed flush against the bulkhead.

i. Correctly position each of the two mounting blocks and weld each in place with a $\frac{1}{4}$ -inch weld at each side and under the bottom.

Note. Be careful not to close the bolt holes in the blocks or to get weld on the block tops where it would interfere with the mounting of the plate.

j. Position the plate and secure it with two bolts and lock washers.

Note. If a catch is not already mounted on the left-center floor panel, proceed as follows:

k. Rotate the handle at the right edge of the plate to place the long axis of the handle at a right angle to the right edge of the plate (fig. 40), with the longer portion of the handle at the left.

Note. The short part of the handle will not project over the top of the left-center floor panel.

l. Engage the catch over the short portion of the handle (fig. 40), with the catch horizontal and projecting down at the left side of the bulkhead (under the floor plate).

m. Hold the catch in position, open the handle and lift the hinged portion of the floor plate out of the way. Weld the catch to the bulkhead with a $\frac{1}{8}$ -inch weld along the right bottom edge.

Note. Plate can now be lowered and latched shut.

34. Installation of Vehicle Accessories and Parts Inside of Vehicle

a. Install the cover over the compartment formerly occupied by the rear ration box (now occupied by the hydraulic-pump-gear-drive propeller shaft).

b. Place the signal-flare tray bracket in the bottom of the compartment which is directly in front of the left air cleaner, in approximately the same position from which the cal. .30 ammunition box

was removed (par. 19), and tack weld it in place with $\frac{1}{8}$ -inch tack welds in four spots. Install the signal-flare tray in the bracket.

c. Install the engine left air cleaner (TM 9-718).

d. Install the plate over the compartment in front of the left air cleaner (compartment now holding the signal-flare tray).

e. Modify the "MANUALS" box by cutting off the two supports and the fastener from the rear of the box, and by then welding the two mounting pads (par. 33) to the back of the box.

Note. The two mounting pads are shipped tied to the turret-compartment left floor plate. These are placed vertically on back of the box about one-half inch in from the edges, and are secured by four $\frac{1}{8}$ -inch tack welds along the inside edge of each pad.

Weld the mounting pads to the hull in front of the driver's seat at the position from which the cal. .30 ammunition box was removed (par. 19), with $\frac{1}{8}$ -inch tack welds at the four surfaces of the mounting pads.

f. Install the blackout-driving-light bracket on the wall to the right of the assistant driver's seat, so that the closest edge of the bracket will be 6 inches above the floor and $2\frac{1}{4}$ inches back from the front wall (fig. 20). Secure the bracket to the wall with $\frac{1}{8}$ -inch tack welds at four points. Install the blackout-driving light in the bracket.

g. Position the battery and spare-bulb bracket on the interior wall of the vehicle turret at right side (gun stowed) just far enough below the turret top for insertion and removal of bracket contents. Bracket is to be just back of the loader's periscope, at this side. Secure bracket by welding the mounting pads to the wall with $\frac{1}{8}$ -inch tack welds at outer sides. Install battery and bulbs.

h. Position the flashlight bracket on the right side of the column to the rear and between the driver's and assistant-driver's seats (fig. 21), at a point approximately opposite the bracket on the left side of the column. Secure the bracket to the column with $\frac{1}{8}$ -inch tack welds at four points. Install flashlight.

35. Installation of Vehicle Accessories on Outside of Vehicle

a. Curl the front end of the tow cable on top of the left-front fender, making a loop to the right to bring the cable end around toward the back of the fender (fig. 41). Spread the loop out so that cable is not kinked in any way, and so that there is room on the fender for all of the slack portion of the cable to lie flat. Locate the cable lock and bracket on top of the fender with the lock around the cable end, and mark on the fender the position taken by the bracket. Hold the two guide clips (shipped in the bulldozer kit) down on the fender at opposite sides of the cable loop near the front, so that they will serve to retain the cable on the fender, and mark the positions of these brackets.

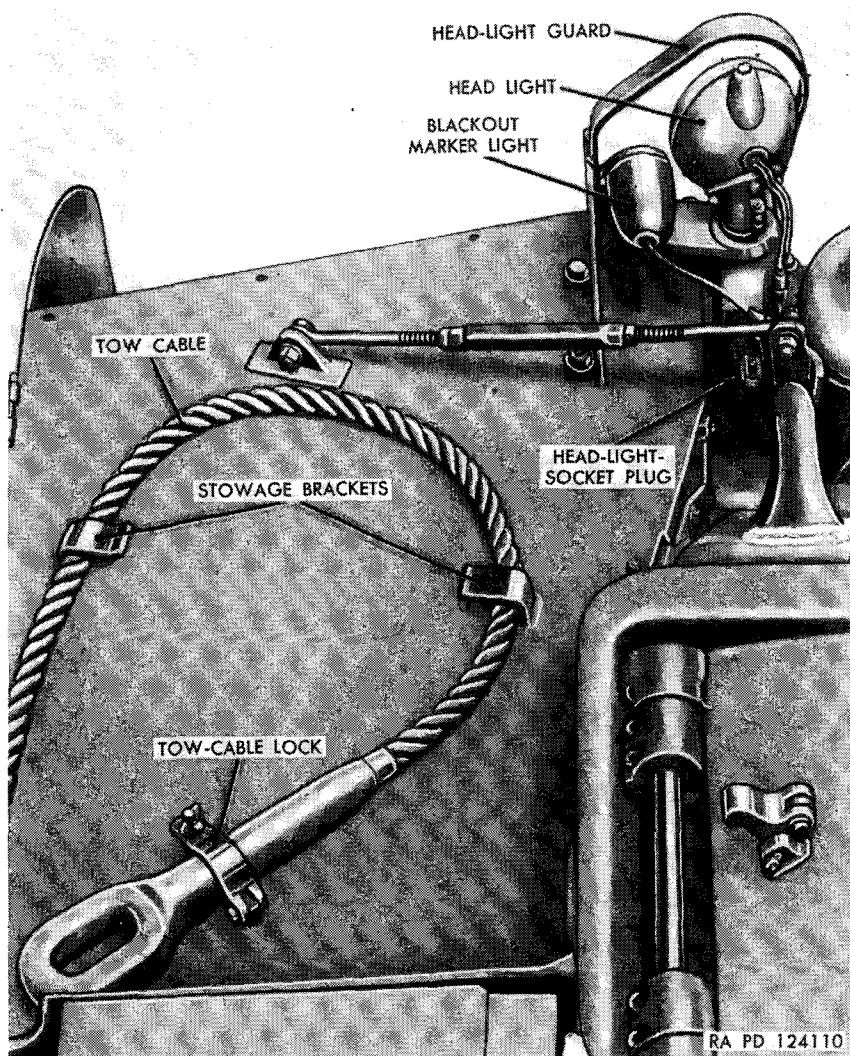


Figure 41. Left head light and tow cable.

Move cable out of the way and weld the cable-lock bracket and the two guide clips to the fender at the positions marked. Use a $\frac{1}{8}$ -inch weld at outer side of each. Place cable end on fender, loop it through the clips and secure the end to the fender with the cable lock.

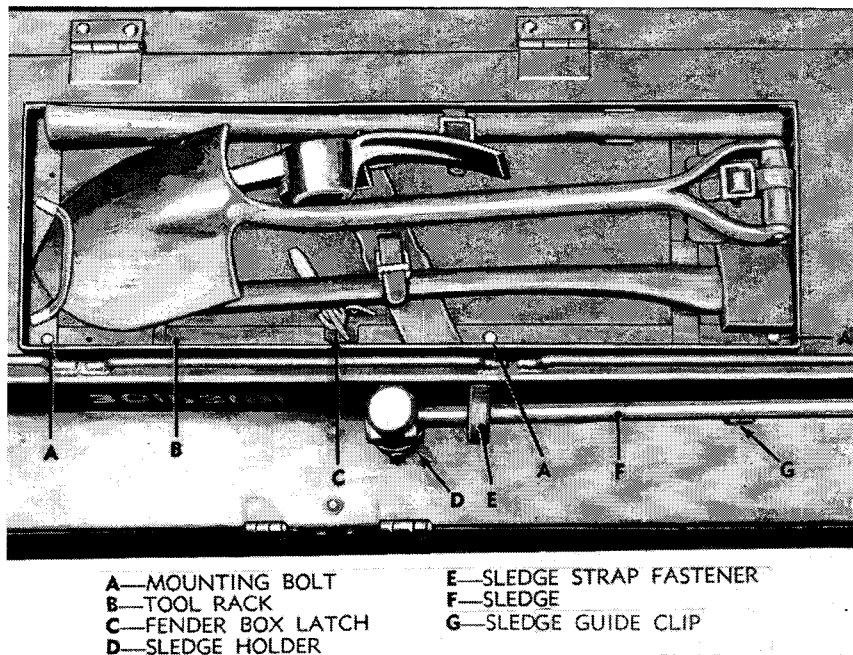
b. Position the tool rack on top of the right-fender box approximately 13 inches back from the front edge of the box cover (fig. 42).

Note. Axe head should be at front, and the right edge of the rack should be pushed outward against the hand holds on the outer edge of the vehicle. The bottom of the rack right edge will ride on top of the cover latch (when latch is closed) and must be cut away to provide clearance for the end of the latch so that it can be operated properly.

Mark area to be cut away at edge of rack, then cut away the rack, as marked, with a torch. Secure the six mounting blocks to the underside of the rack, and reposition it on the vehicle as before. Mark the locations of the mounting blocks, remove them from the rack and secure the six blocks in place on top of the fender-box cover with a $\frac{1}{8}$ -inch weld all around each. Position the rack on the cover and secure it with six bolts. Place all the tools in the rack.

c. Position the sledge on the side of the right-fender box, with the head just below the bottom of the tool rack at approximately the center of the rack.

Note. Head may have to be moved a bit farther back if there is not clearance for the front end of the handle to be flat against the vehicle side.



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Figure 42. Tool rack, tools, and sledge installed.

Position the sledge holder under the sledge head (fig. 42), and mark its location on the vehicle. Position the strap fastener approximately 6 inches in front of the sledge head, with the strap around the handle, and mark the position of the fastener on the vehicle side. Position the guide clip (formerly used to hold sledge handle) below the handle, approximately 12 inches from the front, and mark the position of this clip on side of vehicle (fig. 42). Remove the sledge and weld the holder, fastener, and clip to the vehicle in the positions marked. Replace sledge and tie it in place with the strap.

d. From each head-light bracket removed from the vehicle, remove the blackout-marker light, head light, head-light socket plug, and locking handle. Install these parts in the respective new headlight brackets.

36. Modification and Installation of Vehicle Fenders

a. Lay out on each front-fender section (removed from vehicle) a new front edge contour in accordance with the pattern furnished with the bulldozer kit. Cut away front portion of fender as indicated by layout, smoothing the edge by grinding, if a torch has been used (fig. 43).

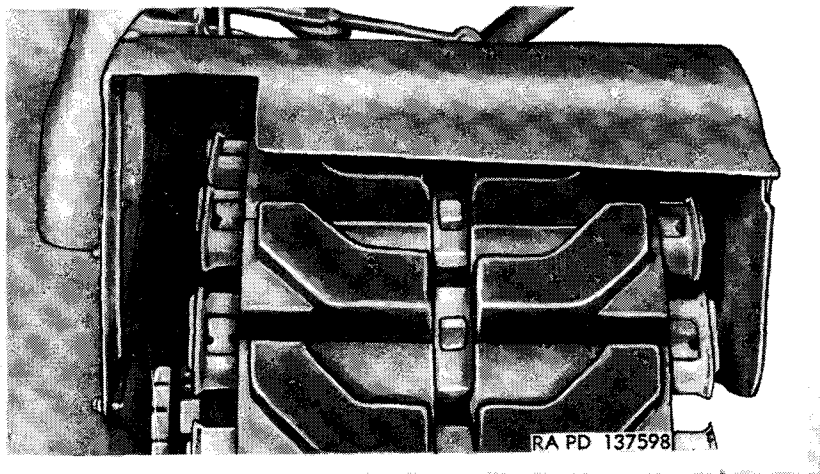
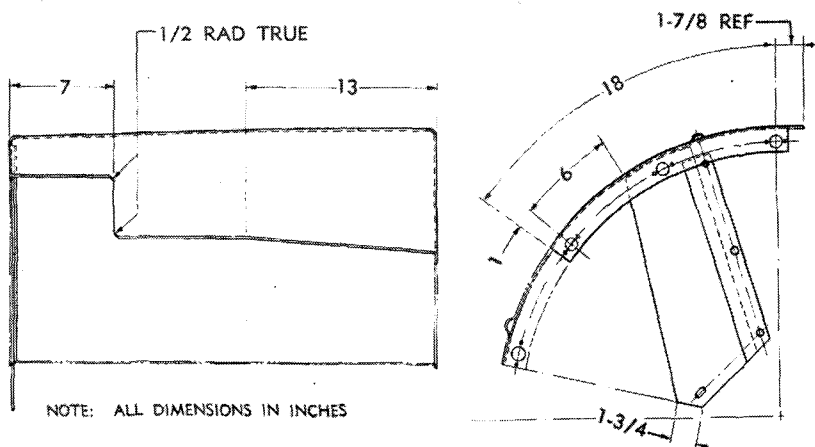


Figure 43. Modified left-front-fender section.

b. Install right-angle brace (the two braces for the two fenders are shipped tied together) under front edge of each fender section remaining on the vehicle, positioning each brace so that one side will be horizontal and the other side will be projecting vertically down just inside the dust shield at the outer side of the fender.

Note. Bolt holes in brace will coincide with bolt holes in fender and dust shield. As same bolts are used to fasten front-fender sections in place, do not actually install bolts until each front fender is installed as follows:

c. Install modified front-fender sections, using bolts, washers, lock washers, and nuts with which section was originally installed.

d. Cut away front portion of each dust shield so that (new) front edge of dust shield will be same distance back from front of vehicle as new front edge of fender. Roll back the front edge of the dust shield to conform with the rolled bottom edge of the shield.

Section II. CONTROLS AND OPERATION

37. General

This section describes, locates, illustrates, and furnishes the operator with sufficient information pertaining to the various controls provided for the proper operation of the bulldozer. It also contains instructions for the mechanical steps necessary to operate the bulldozer under usual conditions.

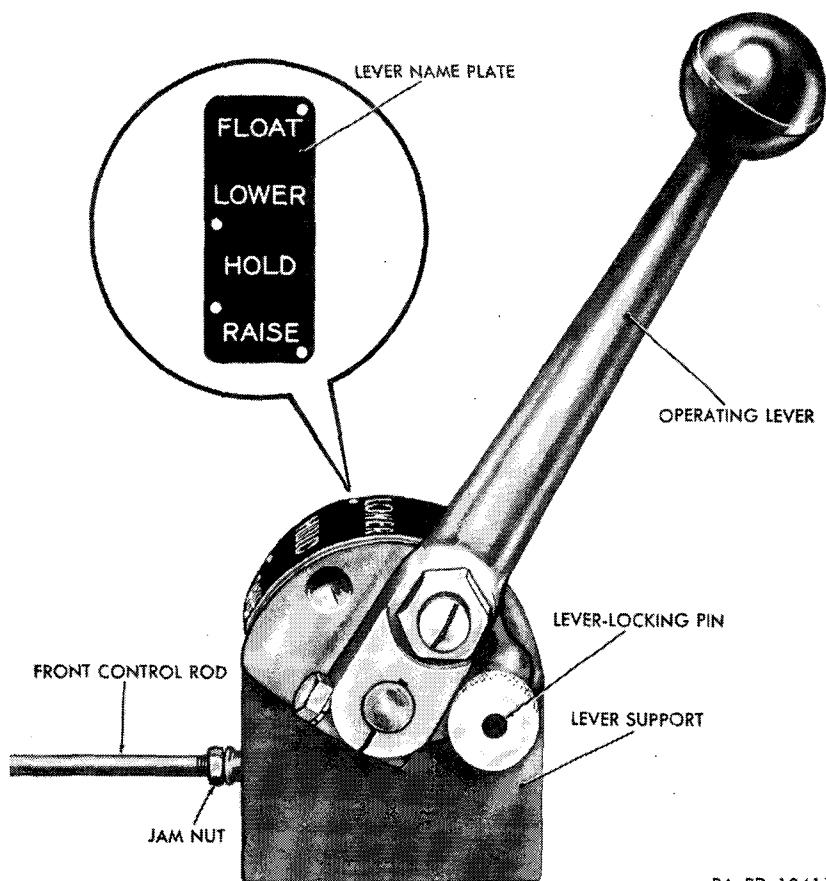
38. Control-Valve-Control Operating Lever

a. The power-driven hydraulic system is operated by means of the control-valve-control operating lever, which is located against the left wall of the vehicle (fig. 33). This lever is connected through linkage to the valve-stem-head link on the hydraulic-pump control valve (fig. 32). An instruction plate secured to the top of the lever support (fig. 44) indicates the four positions of lever operation. These positions are, reading from top to bottom: "FLOAT," "LOWER," "HOLD," and "RAISE." Placing the lever in either the "LOWER" or "RAISE" position will result in corresponding movement of the moldboard. The moldboard will continue to be lowered or raised as long as the lever remains at the position indicated, or until the moldboard has reached the extremity of its travel in the direction indicated. Placing the lever at "HOLD" locks the moldboard at whatever position it is in at the moment. When the lever is moved to "FLOAT," the moldboard can be freely moved by external force, either up or down and, if raised above the ground at the time the

lever is placed in this position, will slowly settle to the ground due to its weight.

b. There is a spring-loaded ball inside the bottom of the control-valve-control operating lever, behind the jam nut (fig. 44), which drops into detents in the lever support whenever the lever is at either the "HOLD" or "FLOAT" position. This detent action of the ball serves to lock the lever in either of these two positions, and considerable force is required to move the lever out of either position.

c. A knurled knob (with integral pin) which can be rotated so that the pin part either rides against the side of the lever, or (when the lever is at "FLOAT" and the knob is turned 90° either way) will be pulled by spring action into a bore in the lever. When the pin part of the knob is pulled into the lever, a locking pin attached to the inner side of the knob is simultaneously thrust (by the same spring action) into a bore in the support. Thus the lever can be



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Figure 44. Control-valve-control operating lever.

securely locked in the "FLOAT" position, and cannot be moved until the knob is pulled outward and rotated a quarter turn (either way) to release it.

39. Carrying-Hooks Operating Lever

Carrying hooks are provided to maintain the moldboard at its extreme elevated position during travel (fig. 34). The engagement and disengagement of these hooks is controlled by the carrying-hooks operating lever (fig. 35). When the lever is moved back and forth it rotates the carrying-hooks-cable drum (fig. 45), which causes the

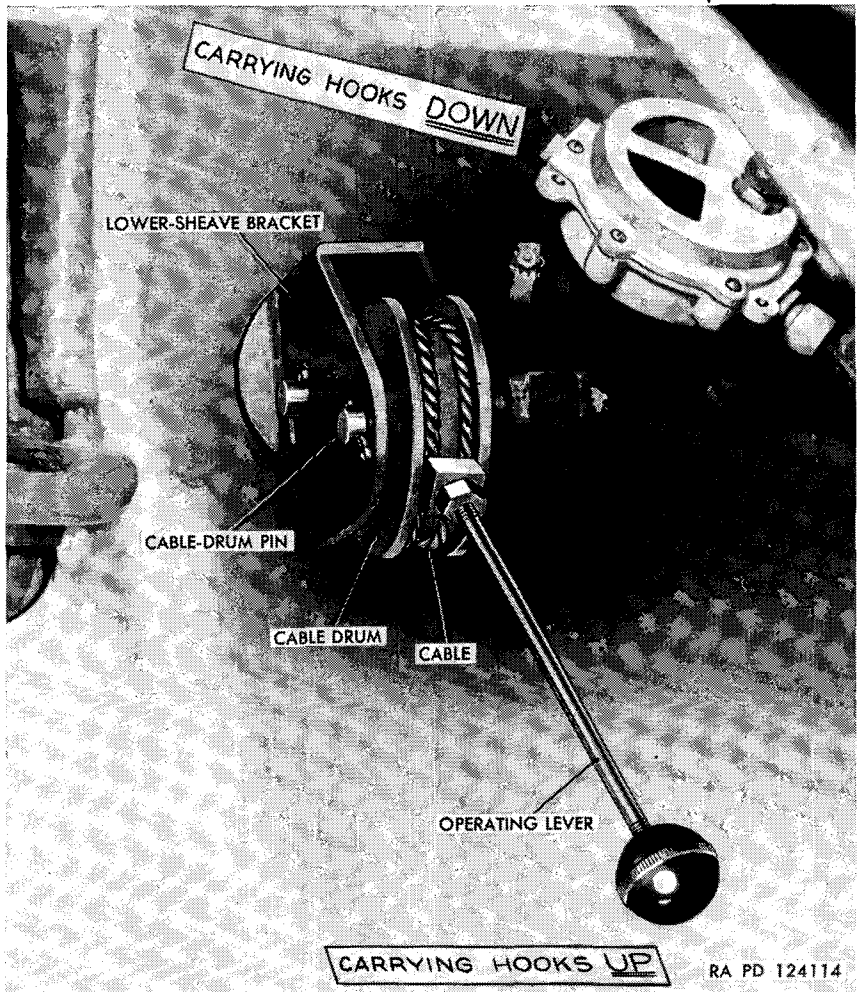


Figure 45. Carrying-hooks hand-control lever.

cable to rotate the carrying-hooks shaft and, with it, the hooks. The lever is mounted on the inside of the hull roof above the driver's right shoulder (fig. 35). When the lever is pushed all the way forward (toward the "CARRYING HOOKS UP" decalcomania on the roof) the carrying hooks are disengaged. Pushing the lever all the way back (toward the "CARRYING HOOKS DOWN" decalcomania) will engage the hooks.

Caution: Engagement or disengagement of the carrying hooks cannot be effected (because of the weight of the moldboard) unless the control-valve operating lever is moved to the "RAISE" position, to lift the weight of the moldboard from the hooks.

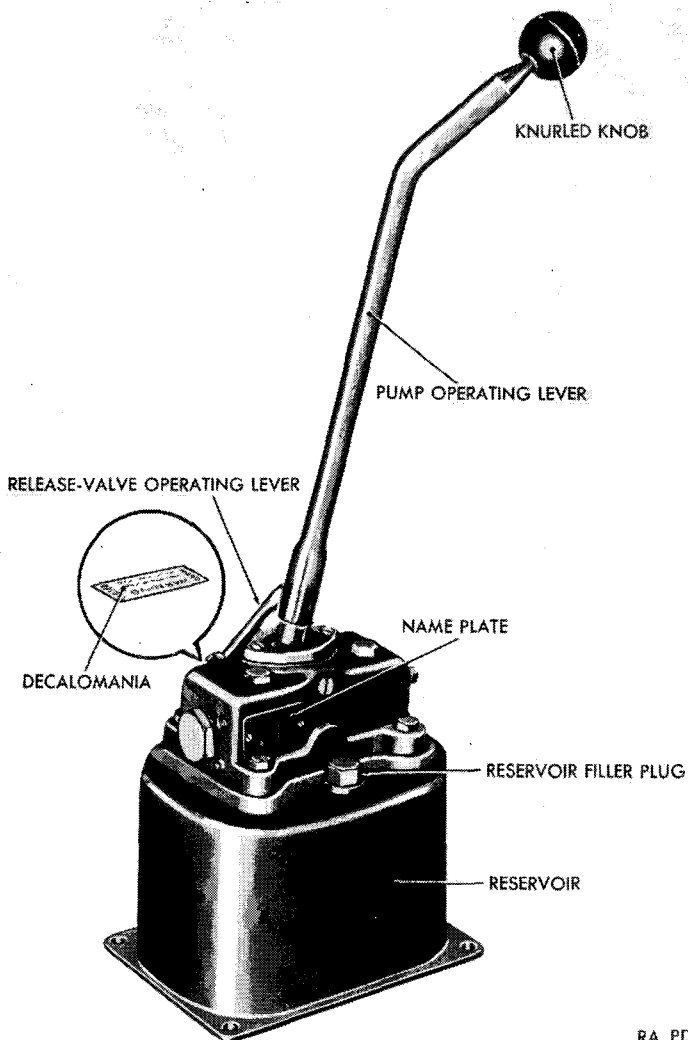
A spring-loaded carrying-hooks pin (Q, fig. 53) engages in a detent in the side of the carrying-hooks-cable drum when the lever is at the "CARRYING HOOKS DOWN" position, and considerable force is required to move the lever from this position.

40. Emergency-Lift Hand-Operated-Pump Operating Lever

Emergency-lift operation of the moldboard to a carrying position is provided by an emergency-lift hand-operated-pump (fig. 37). This pump is operated by means of an operating lever, located on top of the pump (fig. 46). The position of the pump places this handle just to the left of the assistant driver. The lever is operated by a back and forth motion. Movement of the lever pumps hydraulic oil into the emergency-lift hydraulic jack which causes the ram of the jack to extend and exert a lift on the emergency-lift cable, and thereby raise the moldboard. When the ram is fully extended the moldboard is at its extreme raised position and the carrying hooks can be engaged.

41. Control-Valve-Release-Valve Lever

Operation of the emergency-lift pump is controlled by the control-valve-release-valve operating lever. This lever is on top of the emergency-lift pump, just to the right of the pump-operating lever (fig. 46). When the lever is placed in an upright position, the hydraulic system between the emergency-lift pump and the emergency-lift jack becomes a closed hydraulic system—and operation of the pump-operating lever will result in pumping of hydraulic oil into the jack to raise the moldboard. When the lever is moved to a horizontal position, the hydraulic system is opened to the reservoir below the pump. Any hydraulic oil which is in the jack cylinder will flow back into the reservoir due to the weight of the moldboard acting on the jack ram. Placing the lever in the horizontal position, whenever the moldboard is elevated and the carrying hooks are not engaged, will allow the moldboard to slowly settle to the ground.



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Figure 46. Emergency-lift hand-operated-pump and reservoir.

42. Before-Operation Service

a. HYDRAULIC-PUMP RESERVOIR. Loosen the two quarter-turn, self-locking fasteners in the oil-inlet cover and remove the cover (fig. 40). Remove the hydraulic-pump-reservoir filler cap and check the oil level. Add hydraulic oil (fig. 47), if required. The oil level should be flush with the bottom of the elbow below the cap (fig. 32).

b. HAND-OPERATED-PUMP RESERVOIR. Remove the hand-operated-pump-reservoir-filler plug and check the level of oil in the reservoir

(fig. 46). Add hydraulic oil (fig. 47), if necessary. The oil level should be flush with the bottom of the filler plug.

43. Operation of Vehicle With Bulldozer Attached

With the bulldozer attached, operate the vehicle in low gear and in the same manner used for normal operation of the vehicle alone (TM 9-718).

Caution: The turning radius required will be greatly increased whenever the bulldozer moldboard is in digging position.

When first operating the vehicle with the bulldozer attached, raise and lower the moldboard several times to become thoroughly familiar with the operation of the controls (pars. 38 to 41), prior to actual moving of earth or obstacles. Always have the vehicle moving slowly in low gear, before lowering the moldboard to digging position. Lower the moldboard gradually until the desired depth has been reached. With the vehicle moving forward at a steady speed, raise or lower the moldboard, as required, to compensate for uneven ground.

44. Operation of Power-Driven Hydraulic System

a. Whenever the vehicle engine is in operation, the hydraulic-pump gear drive will likewise be in operation. Movement of the moldboard will be subject only to the operation of the control-valve operating lever.

b. As the moldboard should always be carried, when not in use, with the carrying hooks engaged, the first operation necessary is that of disengaging the carrying hooks. To disengage carrying hooks, move the control-valve operating lever (fig. 33) to "RAISE" position, and hold it in this position while moving the carrying-hooks operating lever (fig. 35) to the "CARRYING HOOKS UP" position. Even though the moldboard is at its highest position, it will not damage the hydraulic system to keep the operating lever at "RAISE."

c. If it is not desired to lower the moldboard immediately, move the control-valve operating lever to "HOLD" position. The moldboard will remain in its last position.

d. To lower the moldboard, move the operating lever to "LOWER" position. The moldboard will be continuously lowered, as long as the lever remains in this position, until it reaches the lowest point of its travel. If the lever is allowed to remain at "LOWER" after the moldboard is fully lowered, operation of the hydraulic system

will keep the moldboard in this position without damage to the system.

Note. If the moldboard is to be maintained at this position for any length of time, it is advisable to move the lever back to "HOLD" position.

e. When the lever is moved to "RAISE" position, the moldboard will be steadily raised until it reaches the uppermost point of its travel.

f. The "FLOAT" position is not used during ordinary operation of the bulldozer. It is used for emergency operation (par. 45) and the lever can be locked in this position (par. 38).

g. On completion of a bulldozing operation, move the control-valve operating lever to "RAISE" position to raise the moldboard to its highest position. Hold the lever in this position while moving the carrying-hooks operating lever to the "CARRYING HOOKS DOWN" position to engage the carrying hooks. After the carrying hooks have been engaged, the operating lever can be moved back to "HOLD" position, and the vehicle can be operated without further concern for the bulldozer controls.

45. Operation of Emergency-Lift Hand-Operated Hydraulic System

The emergency-lift hand-operated pump is provided for use only when the power-driven hydraulic system is malfunctioning, and it is desired to raise the moldboard to carrying position. To use the emergency-lift pump, move the control-valve operating lever to "FLOAT" position and lock it in this position. Move the release-valve operating lever (fig. 46) to the upright position to make the emergency-lift system a closed system. Move the operating lever back and forth to raise the moldboard. Hand operate the pump until the moldboard is fully elevated. Then move the carrying-hooks operating lever to the "CARRYING HOOKS DOWN" position to engage the carrying hooks.

Note. Ordinarily, the moldboard will not again be lowered until the bulldozer drive is functioning properly, and will therefore not be lowered by operation of the emergency-lift pump. However, should lowering be required, it will be necessary to operate the pump again to raise the moldboard to its extreme elevated position (it will probably have settled onto the carrying hooks), before the carrying hooks can be disengaged. After disengaging the carrying hooks (par. 39), open the release valve (fig. 46) to lower the moldboard, by moving the release-valve-operating lever to the horizontal position.

Caution: Whenever the moldboard has been elevated by the emergency-lift pump and the carrying hooks have been engaged, always complete this operation by rotating the release-valve lever (fig. 46) to the horizontal position to open the release valve. This will

prevent any subsequent accidental operation of the power-driven hydraulic system while the valve is still closed (and hydraulic oil is trapped in the emergency-lift jack). Movement of the moldboard under such a condition (against the holding pressure of the emergency-lift jack) would damage the equipment. Whenever the moldboard is elevated, the carrying hooks are engaged, the vehicle engine is running, and it is necessary to move the control-valve operating lever to the "FLOAT" position, always move the lever as rapidly as possible past the "LOWER" position—as any delay in the "LOWER" position would result in putting undue strain on the carrying hooks.

46. Operating Precautions

a. When taking a level cut, do not lower the moldboard to such an extent that it will stall the vehicle engine. Take only the depth of cut that can be handled without slowing the speed of the engine too much.

b. Note the up and down motion of the front of the vehicle and compensate for this motion by lowering or raising the moldboard. When the front of the vehicle starts to "nose up," lower the moldboard; when the front of the vehicle starts to "nose down," raise the moldboard, but only far enough to compensate for the vehicle motion.

c. When cutting through very hard material and the engine becomes overloaded, raise the moldboard until the load on the engine is eased.

d. When the moldboard is loaded, lift it slightly before trying to turn the vehicle.

e. When on steep inclines, keep the vehicle in low gear (TM 9-718). Use compression of vehicle engine to hold down the speed.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. PARTS, SPECIAL TOOLS, AND EQUIPMENT FOR ORGANIZATIONAL MAINTENANCE

47. General

Tools, equipment, and spare parts are issued to the using organization for maintaining the matériel. Tools and equipment should not be used for purposes other than prescribed and, when not in use, should be properly stored in the chest and/or roll provided for them.

48. Parts

Spare parts are supplied to the using organization for replacement of those parts most likely to become worn, broken, or otherwise unserviceable, providing such operations are within the scope of organization-maintenance functions. Spare parts, tools, and equipment supplied for the tank-mounting bulldozer M3 are listed in Department of the Army Supply Catalog ORD 7-8 SNL G-246, which is the authority for requisitioning replacements.

49. Common Tools and Equipment

Standard and commonly used tools and equipment having general application to this matériel are listed in the catalog and by T/A and T/O & E. They are not specifically identified in this manual.

50. Special Tools and Equipment

No specially designed tools and equipment for organizational maintenance, repair, and general use with the tank-mounting bulldozer M3 are required.

Section II. LUBRICATION AND PAINTING

51. Lubrication Order

Lubrication Order LO 9-723 (fig. 47) prescribes cleaning and lubricating procedures as to locations, intervals, and proper materials for this bulldozer. This order is issued with each bulldozer and is to be carried with the vehicle on which the bulldozer is mounted at all

times. In the event that a bulldozer is received without a copy, the using organization shall immediately requisition one. See SR 310-20-4.

LUBRICATION ORDER

LO 9-723

BULLDOZER, TANK MOUNTING, M3

References: TM 9-723, ORD 7 SNL G-246

Intervals given are maximums for normal 8-hour day operation. For abnormal conditions or activities, intervals should be adjusted to compensate.

A, Fig 48

HYDRAULIC OIL RESERVOIR FILL AND LEVEL—Check level daily, before operation, with moldboard lowered to ground and engine running. Fill to bottom of filler pipe elbow with OHA. CAUTION: Do not over fill.

D, Fig 48

HYDRAULIC OIL RESERVOIR DRAIN—Drain every 300 hours. Drain only after operation. Flush system with TPM or SD. Refill to proper level. Operate moldboard up and down a few times and recheck level. (Approximate capacity 30 gallons).

E, Fig 48

EMERGENCY LIFT HOIST FILL AND LEVEL—Check level daily, before operation, with moldboard in raised position. Fill to plug level with OHA.
EMERGENCY LIFT HOIST DRAIN—Drain once a year. Flush system with TPM or SD. Refill to plug level. Operate hand pump to raise and lower moldboard and recheck level. (Approximate capacity 1 gallon).

B, Fig 48

HYDRAULIC OIL PUMP DRIVE CASE FILL AND LEVEL—Check level daily, before operation. Fill to plug level with OE 30 above +32° F, OE 10 from +40° F to -10° F, OES from 0° F to -65° F.

C, Fig 48

HYDRAULIC OIL PUMP DRIVE CASE DRAIN—Drain every 300 hours. Drain only after operation. Refill to plug level. (Approximate capacity 1½ pints).

F, Fig 48

HYDRAULIC OIL PUMP DRIVE SHAFT SLIP JOINT—Weekly, lubricate through fitting with CG above 0° F, OG 00 below 0° F.

G, Fig 48

CABLES—Monthly, clean emergency lift cable and carrying hook lift cable with TPM or SD and coat with CT.
OIL CAN POINTS—Daily, lubricate all control linkage, clevises and pins with PL (Med) above +32° F, PL (Special) below +32° F.
DO NOT LUBRICATE—Exterior pivots, trunnions and cable sheave pins.
LUBRICATED AT TIME OF DISASSEMBLY BY ORDNANCE PERSONNEL—Hydraulic oil pump drive shaft universal joints.

LUBRICANTS

OE —OIL, lubr, engine

OES —OIL, lubr, engine, sub-zero

PL —OIL, lubr, preservative

OHA—OIL, hydraulic, petroleum base

OG —GREASE, lubr, Ord Dept

CG —GREASE, lubr, general purpose

CT —COMPOUND, rust preventive, thin film

SD —SOLVENT, dry cleaning

TPM —THINNER, paint, volatile mineral spirits

Copy of this lubrication order will remain with the equipment at all times; instructions contained herein are mandatory and supersede all conflicting lubrication instructions dated prior to the date of this lubrication order:

BY ORDER OF THE SECRETARY OF THE ARMY:

Official:

EDWARD F. WITSELL

Major General, USA

The Adjutant General

J. LAWTON COLLINS

Chief of Staff, United States Army

RA PD 124116

Figure 47. Lubrication order—LO 9-723

52. General Lubrication Instructions

a. USUAL CONDITIONS. Service intervals specified on the lubrication order are for normal operation where moderate temperature, humidity, and atmosphere conditions prevail.

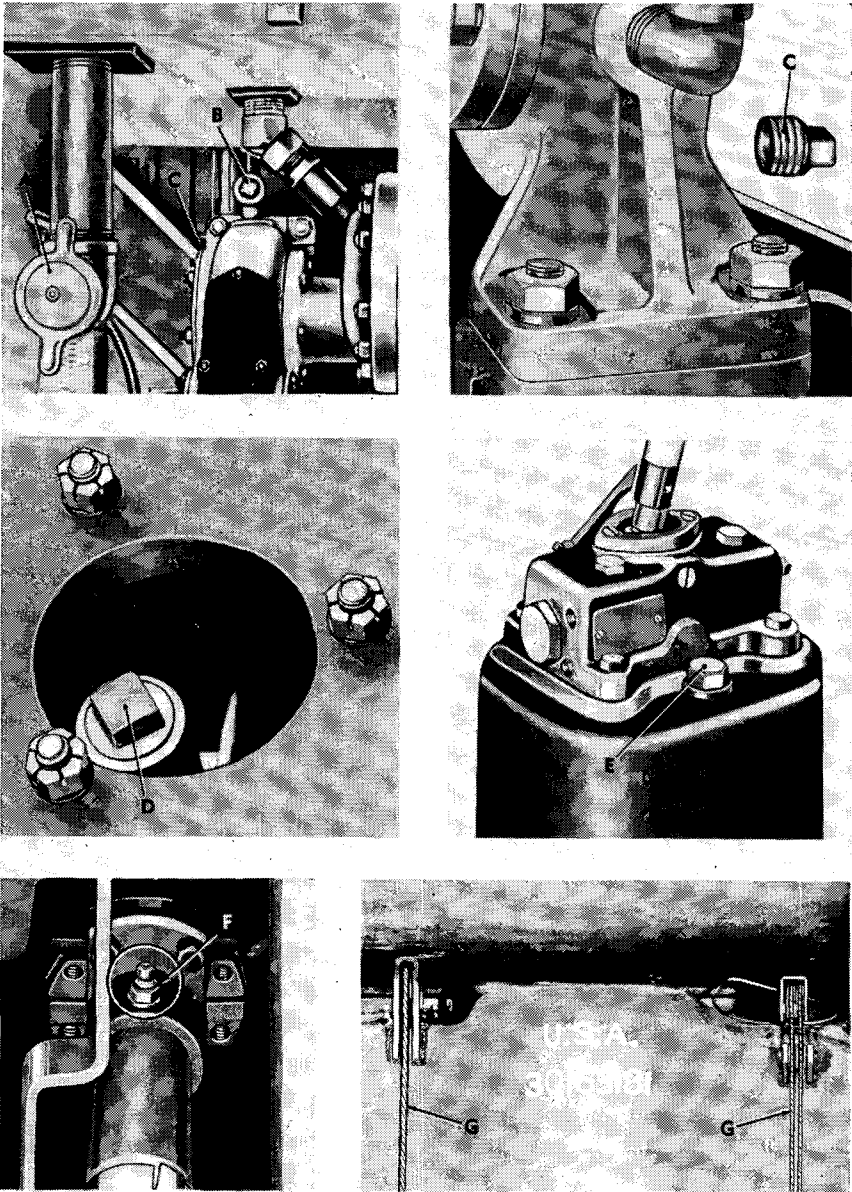
b. LUBRICATION EQUIPMENT. Each vehicle is supplied with lubrication equipment adequate for maintenance of the bulldozer mounted thereon. Clean this equipment both before and after use. Operate

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the lubricating guns carefully and in such a manner as to insure a proper distribution of the lubricant.

c. POINTS OF APPLICATION.

- (1) Lubricating fittings, oilers, and oilholes are shown in figure 48 and are referenced to the lubrication order. Wipe these



RA PD 124117

Figure 48. Localized lubrication views.

devices and the surrounding surfaces clean before and after lubricant is applied. Remove any metal particles which have adhered to the magnetic drain plug of the hydraulic-pump gear drive, whenever plug is removed.

- (2) A $\frac{3}{4}$ -inch red circle should be painted around each lubricating fitting and oilhole.

d. REPORTS AND RECORDS.

- (1) Report unsatisfactory performances of bulldozer, or defects in the application or effect of prescribed lubricants, and preserving materials, using DA AGO Form 468 (Unsatisfactory Equipment Report).
- (2) Maintain a record of lubrication of the bulldozer on WD AGO Form 460 (Preventive Maintenance Roster).

53. Painting

Instructions for the preparation of the matériel for painting, methods of painting, and materials to be used are contained in TM 9-2851.

Section III. PREVENTIVE MAINTENANCE SERVICES

54. General

a. RESPONSIBILITY AND INTERVALS. Preventive maintenance services are the responsibility of the using organization. These services consist generally of before-operation, during-operation, at-the-halt, after-operation, and weekly services performed by the driver or operator and the scheduled services to be performed at designated intervals by organization mechanic or maintenance crews. Intervals are based on normal operations. Reduce intervals for abnormal operations or severe conditions. Intervals during inactive periods may be extended accordingly.

b. DEFINITION OF TERMS. The general inspection of each item applies also to any supporting member or connection and is generally a check to see whether the item is in good condition, correctly assembled, secure, and not excessively worn.

- (1) The inspection for "good condition" is usually an external visual inspection to determine whether the unit is damaged beyond safe or serviceable limits. The term "good condition" is explained further by the following: not bent or twisted, not chafed or burred, not broken or cracked, not bare or frayed, not dented or collapsed, nor torn or cut, not deteriorated.
- (2) The inspection of a unit to see that it is "correctly assembled" is usually an external visual inspection to see whether or not it is in its normal assembled position in the vehicle.

- (3) Inspection of a unit to determine if it is "secure" is usually an external visual examination or a wrench, hand-feel, or a pry-bar check for looseness. Such an inspection must include any brackets, lock washers, lock nuts, locking wires, or cotter pins used.
- (4) By "excessively worn" is meant worn beyond serviceable limits, or to a point likely to result in failure if the unit is not replaced before the next scheduled inspection.

55. Cleaning

a. GENERAL. Any special cleaning instructions required for specific mechanisms or parts are contained in the pertinent section. General cleaning instructions are as follows:

- (1) Use dry-cleaning solvent or volatile mineral spirits paint thinner to clean or wash grease or oil from all parts of the bulldozer.
- (2) A solution of one part grease-cleaning compound to four parts of dry-cleaning solvent or volatile mineral spirits paint thinner may be used for dissolving grease and oil from components of the bulldozer. After cleaning, use cold water to rinse off any solution which remains.
- (3) Use clean water, or a soap solution of one-fourth pound of soap chips to a gallon of hot water, for all rubber parts and over-all general cleaning of painted surfaces.
- (4) After the parts are cleaned, rinse and dry them thoroughly. Take care to keep the parts clean.
- (5) Remove the protective grease coating from new parts, since this grease is usually not a good lubricant.

b. GENERAL PRECAUTIONS IN CLEANING.

- (1) Dry-cleaning solvent or volatile mineral spirits paint thinner is inflammable and should not be used near an open flame. Fire extinguishers should be provided when these materials are used. In addition, they evaporate quickly and have a drying effect on the skin. If used without gloves, they may cause cracks in the skin and, in the case of some individuals, a mild irritation or inflammation. Use only in well-ventilated places.
- (2) Avoid getting products such as dry-cleaning solvent or volatile mineral spirits paint thinner or lubricants on rubber parts, as they will deteriorate the rubber.
- (3) The use of gasoline or benzine for cleaning is prohibited.

56. Preventive Maintenance by Driver or Operator

a. **PURPOSE.** To insure mechanical efficiency, it is necessary that the bulldozer be systematically inspected at intervals, each day it is operated and also weekly, so defects may be discovered and corrected before they result in serious damage or failure. Certain scheduled maintenance services will be performed at these designated intervals. Any defects or unsatisfactory operating characteristics beyond the scope of the driver or operator to correct must be reported at the earliest opportunity to the designated individual in authority. The services set forth in table III are those performed by the driver or operator before-operation, during-operation, at-the-halt, after-operation, and weekly.

b. **SERVICES.** Driver and crew preventive maintenance services are listed in table III. Every organization must thoroughly school its personnel in performing the maintenance procedures for this bulldozer as set forth in this manual.

Table III. Driver's or operator's preventive-maintenance services

Intervals					Procedure
Before-Operation	During-Operation	At-the-halt	After-Operation	Weekly	
X	-----	X	X	X	<p>Caution: Place all tags describing condition of bulldozer components in the driver's compartment in a conspicuous location so that they will not be overlooked.</p> <p>(1) <i>Oil.</i> Check the amount of oil in the hydraulic-pump and hand-operated-pump reservoirs (fig. 47). Add hydraulic oil as necessary. Also, check level of oil in the hydraulic-pump-gear-drive case (fig. 47) and add oil, as necessary.</p> <p>(2) <i>Oil leaks, general.</i> Check around the hydraulic pump, hand-operated pump, hydraulic cylinders, control valve, hydraulic jack, and lines and fittings for any indication of oil leaks.</p> <p>(3) <i>Visual inspection of equipment.</i> Inspect the entire equipment for any visible damage that would make the equipment unfit for use. Inspect the moldboard cutting edge to make certain it is securely mounted and is not bent or dulled.</p>
X	-----	X	X	X	
X	-----	X	X	X	

Table III. Driver's or operator's preventive-maintenance services—Continued

Intervals					Procedure
Before-Operation	During-Operation	At-the-halt	After-Operation	Weekly	
X	X	-----	-----	X	(4) <i>Controls</i> . With the engine running (TM 9-718), operate the power-driven hydraulic system (par. 44) to determine whether or not the controls are in good operating condition. Stop engine and operate the emergency-lift hand-operated hydraulic system (par. 45). Adjust control-valve operating lever as necessary (par. 25).
	X	-----	-----	-----	(5) <i>Operating observations</i> . While the bulldozer is in operation, be alert for any sounds such as rattles, knocks, or squeaks that may be signs of trouble. Note any unusual or unsatisfactory performance. Any unusual noises or unsatisfactory performance should be investigated at the next halt.
			X	X	(6) <i>Clean equipment</i> .
				X	(a) Wipe dirt, oil, and grease off all components of equipment.
					(b) Wash all components thoroughly, when possible.
X	-----	-----	-----	X	(7) <i>Cables</i> . Carefully examine the emergency-lift and carrying-hooks cables for stretching and for abnormal wear. Adjust cables if necessary (pars. 28 and 31).
X	-----	-----	-----	X	(8) <i>Decalcomanias and instruction plates</i> . Check to see that the lubrication order (par. 51), the two carrying-hooks instruction decalcomanias (par. 5), the emergency-lift-operation decalcomania, emergency-lift-hand-operated-pump decalcomania, and the control-valve-operating-lever instruction plate are in good condition.
				X	(9) <i>Publications</i> . Check to see that TM 9-723, TM 9-718, and ORD 7-8 SNL G-246 are on hand and in good order.
			X	X	(10) <i>Lubrication</i> . Lubricate equipment in accordance with instructions contained in LO 9-723 (fig. 47).

57. Preventive Maintenance by Organizational Maintenance Mechanics

a. INTERVALS. The indicated frequency of the prescribed preventive maintenance services is considered a minimum requirement for normal operation of the bulldozer. Under unusual conditions, such as extreme temperatures, dust or sand, or extremely wet terrain, it may be necessary to perform certain maintenance services more frequently.

b. OPERATOR PARTICIPATION. The operator should accompany the bulldozer and assist the mechanics while periodic organizational preventive maintenance services are performed. Ordinarily, the operator should present the bulldozer for a scheduled preventive-maintenance service in a reasonably clean condition.

c. SPECIAL SERVICES. The special services are as follows:

- (1) *Adjust.* Make all necessary adjustments in accordance with the pertinent section of the manual, technical bulletins, or other current directives.
- (2) *Clean.* Clean the bulldozer as outlined in paragraph 55 to remove old lubricant, dirt, and other foreign material.
- (3) *Special lubrication.* This applies either to lubrication operations that do not appear on the bulldozer lubrication order or to items that do appear on the order but which should be performed in connection with the maintenance operations, if parts have to be disassembled for inspection or service.
- (4) *Serve.* This usually consists of performing special operations, such as draining and refilling units with oil.
- (5) *Tighten.* All tightening operations should be performed with sufficient wrench torque (force on the wrench handle) to tighten the unit according to good mechanical practice. Use a torque-indicating wrench where specified. Do not overtighten, as this may strip threads or cause distortion. Tightening will always be understood to include the correct installation of lock washers, lock nuts, lock wire, or cotter pins provided to secure the tightening.

d. SPECIAL CONDITIONS. When conditions make it difficult to perform the complete preventive maintenance procedures at one time, they can sometimes be handled in sections, planning to complete all operations within the week if possible. All available time at halts and in bivouac areas must be utilized, if necessary, to assure that maintenance operations are completed. When limited by the tactical situation, items with special services in the columns should be given first consideration.

e. PROCEDURES. Table IV lists the services to be performed by the organizational mechanic or maintenance crew at the designated intervals. Each page of the table has two columns at its left edge corresponding to quarterly and monthly maintenance respectively. Very often it will be found that a particular procedure does not apply to both scheduled maintenances. In order to determine which procedure to follow, look down the column corresponding to the maintenance procedure, and wherever an item number appears, perform the operations indicated opposite the number.

Table IV. Organizational mechanic or maintenance crew preventive maintenance services

Intervals		Procedure
Monthly	Quarterly	
		ROAD TEST
X	-----	<i>Power-driven hydraulic system.</i> Operate bulldozer (par. 44). Check for hydraulic-oil leakage at hydraulic pump, control valve, hydraulic cylinders, and at all hydraulic-line connections.
X	-----	<i>Emergency-lift hand-operated hydraulic system.</i> Operate the hand-operated pump (par. 45). Check for oil leakage at the pump, hydraulic jack, and at the oil-line connections.
X	-----	<i>Carrying hooks.</i> Operate the carrying-hooks-hand-control lever (par. 45) to determine whether or not hooks will properly engage and disengage.
		MAINTENANCE OPERATIONS
X	-----	<i>Moldboard, tilt arms, and push beams</i> (fig. 49). Examine carefully for cracks or distortion.
X	-----	<i>Hydraulic-cylinder inner and outer brackets, inner-tilt-arm brackets, push-beam brackets, and carrying-hooks-shaft brackets.</i> Examine carefully for cracks or distortion, especially around the welds.
X	X	<i>Pins</i> (fig. 49). Examine pins which attach the moldboard to the push beams, the push beams to the push-beam brackets, the inner tilt arms to the inner-tilt-arm brackets, and the hydraulic-cylinder rams to the push beams. Also examine the stub shafts by which the hydraulic cylinders are retained in their brackets. Check for distortion or wear. Tighten nuts and/or bolts which secure the pins.
X	X	<i>Carrying-hooks shaft</i> (fig. 53). Examine shaft for distortion. Tighten carrying-hooks set screws and the two screws which screw the cable-drum-body plate to the cable-drum body.

Table IV. Organizational mechanic or maintenance crew preventive maintenance services—Continued

Intervals		Procedure
Monthly	Quarterly	
X	X	<i>Hydraulic cylinders</i> (fig. 68). Examine the cylinder rams for distortion or scoring. Tighten the eight bolts that secure each cylinder cover to the cylinder and the two screws that secure each cylinder-ram packing gland to the cover.
X	X	<i>Cables</i> (figs. 53 and 54). Examine emergency-lift and carrying-hooks cables for fraying and/or looseness of connections.
X	X	<i>Control-valve operating lever and linkage</i> (fig. 56). Test operation of lever detent stops and of the locking-pin knurled knob (par. 38). Operate bulldozer (par. 44) and test for correct response at four lever positions (par. 38). Adjust linkage (par. 25), if necessary. Tighten two screws and nuts that secure the lever support to the mounting bracket (fig. 33), the screws that tighten the three yokes to the front rod and valve-control shaft, the set screw in the control shaft collar, screw and nut that secure the rear-rod-end eye to the valve-stem-head link (on the control valve), the two screws and nuts that secure the rear link to the control-valve-stem head, and the four screws that secure the two valve-control-shaft supports to their mounting pads.
	X	<i>Hydraulic pump</i> (fig. 63) and <i>pump gear drive</i> (fig. 67). Tighten six screws that secure pump to gear-drive case, and the 12 bolts and nuts that hold the two covers to the pump housing. Tighten 34 nuts which secure the five covers to the sides of the gear-drive case and the four nuts that secure the top cover to the case. Tighten four nuts that secure the gear-drive case to the gear-drive support, and the four screws that secure the support to the vehicle floor support (at front) and the mounting-plate support (at rear).
	X	<i>Hydraulic-pump propeller shaft</i> (fig. 57). Tighten eight screws that secure the journal at the front end of shaft to the shaft assembly and to the hydraulic-pump-gear-drive splined flange and the eight screws that secure the journal at rear end of shaft to the shaft slip yoke and the shaft coupling flange. Check rear end of shaft, around the slip yoke, for signs of grease leakage, and shake the shaft in the yoke to test it for looseness. The play between the shaft and the yoke should be barely noticeable, and any dry "clicking" sound would indicate need for lubrication (fig. 47).
	X	<i>Emergency-lift hand-operated pump</i> (fig. 71). Check tightness of four screws used to mount the pump on its mounting plates, the four screws which secure the pump housing to the reservoir, the plunger cap, the screw that secures the release-valve operating lever to the release valve, the two screws that secure the plunger-operating-lever-packing retainer to the housing, and the two outlet-check-valve-spring retainers. Inspect the pin that attaches the operating lever to the plunger-operating lever.

Table IV. Organizational mechanic or maintenance crew preventive maintenance services—Continued

Intervals		Procedure
Monthly	Quarterly	
	X	<i>Emergency-lift hydraulic jack</i> (fig. 54). Examine the jack plunger for distortion or scoring. Check tightness of two screws that hold the mounting clamp to the mounting blocks, the two screws that hold the cable clip to the sheave support at the end of the jack piston, the bleeder screw in the side of the jack cylinder, and the four screws that hold the four pins used to support the sheaves and jack in the mounting bracket and the sheave at the end of the jack piston. Also, check tightness of screw that holds the sheave pin in the cable-outer-sheave support (fig. 38), and the screw that holds the sheave pin in the bracket on the right-inner tilt arm (fig. 39).
	X	<i>Hydraulic-pump control valve</i> (fig. 60). Check tightness of four bolts which secure the control valve to the reservoir, and the six screws which secure the two covers to the valve body.
	X	<i>Hydraulic-pump oil reservoir</i> (fig. 58). Drain and flush as instructed in the lubrication order (fig. 47). Check tightness of four screws that secure reservoir to the mounting plate, and four screws and nuts that secure the plate to the vehicle floor supports.
	X	<i>Emergency-lift hand-operated-pump oil reservoir</i> (fig. 71). Drain and flush as instructed in the lubrication order (fig. 47).
	X	<i>Hydraulic-pump-gear-drive case</i> (fig. 67). Drain as instructed in the lubrication order (fig. 47). Wipe off metal particles that are adhering to the magnetic drain plug.
		FINAL ROAD TEST
		Perform final test as outlined under ROAD TEST at beginning of this table. Pay special attention to any items which have been repaired or adjusted.

Section IV. TROUBLE SHOOTING

58. Scope

a. This section contains trouble-shooting information and tests for locating and correcting some of the troubles which may develop in the bulldozer. Trouble shooting is a systematic isolation of defective components by means of an analysis of the bulldozer trouble symptoms, testing to determine the defective components, and applying the remedies. Each symptom of trouble given for an individual unit or system is followed by a list of probable causes of the trouble and suggested procedures to be followed.

b. This manual cannot cover all possible troubles and deficiencies that may occur under the many conditions of operation. If a specific trouble, test, and remedy therefor is not covered herein, proceed to isolate the system in which the trouble occurs and then locate the defective component. Use all the senses to observe and to locate troubles. Question the bulldozer operator to obtain maximum number of observed symptoms. The greater the number of symptoms of troubles that can be evaluated, the easier will be the isolation of the defective system and components thereof.

59. Power-Driven Hydraulic System

a. CONTROL-VALVE-CONTROL OPERATING LEVER WILL NOT MOVE.

- (1) *Control-linkage front or rear rod bent.* Inspect rods (fig. 33) and straighten bent rod(s) or replace with new rod(s) (par. 25).
- (2) *Control-linkage out of adjustment.* Adjust linkage (par. 25).
- (3) *Control-valve stem "frozen."* Replace control valve (par. 85).

b. CONTROL-VALVE-CONTROL OPERATING LEVER IS HARD TO MOVE.

- (1) *Valve-control shaft too tight in supports* (fig. 33). Check to see if shaft is bent or otherwise damaged to cause it to bind. Check for accumulation of dirt in support bores and see if supports have become loosened or "cocked" on their mounting pads. Straighten or replace shaft and clean and properly secure the supports (par. 25). To clean parts wash thoroughly with dry-cleaning solvent or volatile mineral spirits paint thinner.
- (2) *Control-shaft collar too far over against support* (fig. 33). Reposition collar (par. 25).
- (3) *Spring behind jam nut too stiff* (fig. 55). Remove the clean spring and spring retainer (par. 87), or replace spring. Clean parts by washing thoroughly in dry-cleaning solvent or volatile mineral spirits paint thinner.

c. CONTROL-VALVE-CONTROL OPERATING LEVER MOVES TOO FREELY. Spring behind jam nut too weak or broken (fig. 55). Tighten jam nut, or replace spring (par. 87).

d. LEVER LOCKING PIN WILL NOT RELEASE, OR WILL NOT HOLD.

- (1) *Spring behind knurled knob clogged with dirt* (fig. 55). Clean spring by washing thoroughly in dry-cleaning solvent or volatile mineral spirits paint thinner.
- (2) *Spring behind knurled knob is defective.* Replace spring (par. 87).

e. MOLDBOARDS FAIL TO MOVE.

- (1) *Oil level in hydraulic-pump reservoir too low.* Fill reservoir (par. 27).

- (2) *Control-valve-control-operating-lever linkage out of adjustment.* Adjust linkage (par. 25).
- (3) *Oil leakage in hydraulic lines.* Inspect all hydraulic lines and connections. Replace lines and connections, as required (pars. 75 and 90).

Note. A leak or break of major proportion can be expected, rather than a small leak, if there is absolutely no movement of moldboard even though reservoir has been filled.

- (4) *Oil leakage from hydraulic pump, control valve, or hydraulic cylinders.* Replace pump (par. 91), control valve (par. 89), or cylinder(s) (par. 74).
 - (5) *Hydraulic-pump propeller shaft or gear drive damaged.* Replace propeller shaft (pars. 94 to 96) or gear drive (par. 92).
 - (6) *Clogged hydraulic lines.* Remove all lines and connections, eliminate obstructions, and install the lines (pars. 75 and 90).
- f. **MOLDBOARD MOVES TOO SLOWLY.**

- (1) *Air in hydraulic lines.* Fill hydraulic-pump reservoir as required (par. 27).
- (2) *Control-valve-control-operating-lever linkage out of adjustment.* Adjust linkage (par. 25).
- (3) *Relief valve in hydraulic-pump control valve opening too soon.* Adjust valve (par. 89c).
- (4) *Oil leakage in hydraulic lines.* Inspect all lines and connections. Tighten and/or replace lines and connections as necessary (pars. 75 and 90).

Note. A very small (high pressure) leak will be sufficient to cause erratic movement of moldboard.

- (5) *Oil leakage from hydraulic pump, control valve, or hydraulic cylinders.* Replace pump (par. 91), control valve (par. 89), or cylinder(s) (par. 74), as required.

g. **MOLDBOARD SETTLES SLOWLY WHEN CONTROL-VALVE-CONTROL OPERATING LEVER IS AT "HOLD" POSITION.**

- (1) *Control-valve-control-operating-lever linkage out of adjustment.* Adjust linkage (par. 25).
- (2) *Relief valve in hydraulic-pump control valve not seating properly.* Replace relief valve (pars. 104 and 108) or, if this does not correct trouble, replace control valve (par. 89).
- (3) *Oil leakage in hydraulic cylinders.* Replace cylinder(s) (par. 74).

h. **MOLDBOARD MOVES IN ONE DIRECTION, BUT FAILS TO MOVE OR MOVES ERRATICALLY IN THE OTHER DIRECTION.**

- (1) *Control-valve-control-operating-lever linkage out of adjustment.* Adjust linkage (par. 25).

- (2) *Hydraulic-pump control valve malfunctioning.* Replace control valve (par. 89).

i. **MOLDBOARD FAILS TO "FLOAT" WHEN OPERATING LEVER IS MOVED TO THIS POSITION.** If operation at the other three lever positions is satisfactory, but is not satisfactory at the "FLOAT" position, there is a malfunction in the control valve. Replace control valve (par. 89).

60. Moldboard Linkage

a. **MOLDBOARD FAILS TO RAISE HIGH ENOUGH FOR ENGAGEMENT OF CARRYING HOOKS**

- (1) *Linkage clogged.* Inspect all mechanical linkages at front of vehicle, by which moldboard is suspended or moved, for interference caused by dirt or rocks wedged between the members. Remove obstructions.
- (2) *Interference with carrying hooks.* Inspect the two carrying hooks (fig. 34) for looseness on the carrying-hooks shaft which would permit either or both hooks to drop down and interfere with elevation of moldboard. Tighten hooks as necessary (par. 28).

Note. Proper position of each hook can be determined by locating the set-screw bore in the shaft (A, fig. 53).

- (3) *Linkage out of line.* Replace linkage (pars. 67 and 69).

b. **MOLDBOARD FAILS TO "DIG IN" PROPERLY.**

- (1) *Moldboard cutting edge loose or damaged.* Inspect the cutting edge. If loose, tighten the nuts on the plow bolts which secure the cutting edge to the moldboard. If excessively worn, replace cutting edge (pars. 63 and 64).
- (2) *Moldboard or linkages out of line.* Replace moldboard (pars. 65 and 66) or linkage (pars. 67 and 69).

61. Emergency-Lift Hand-Operated Hydraulic System

a. **HAND-OPERATED-PUMP OPERATING LEVER WILL NOT MOVE. HAND-OPERATED PUMP MALFUNCTIONING.** Replace pump (pars. 83 and 84).

b. **MOLDBOARD FAILS TO MOVE.**

- (1) *Emergency lift cable movement obstructed.* Inspect the emergency-lift cable (fig. 38) for freedom of movement throughout its length. Remove any obstructions to cable movement.
- (2) *Oil level in hand-operated-pump reservoir too low.* Fill reservoir (par. 32).

- (3) *Oil leakage in hydraulic line between hand-operated pump and hydraulic jack.* Tighten connections and/or replace hose and connections as required (par. 30).
- (4) *Clogged hydraulic line between hand-operated pump and hydraulic jack.* Remove the hose and connections, eliminate obstruction, and install the hose and connections (par. 30).
- (5) *Oil leakage from the hand-operated pump.* Replace pump (pars. 83 and 84).
- (6) *Hydraulic jack leaking or damaged so that ram will not extend.* Replace jack (par. 80).
- (7) *Emergency-lift cable or cable sheaves damaged.* Replace cable (par. 81), and/or sheaves (par. 82).

c. MOLDBOARD FAILS TO RAISE UP HIGH ENOUGH FOR ENGAGEMENT OF CARRYING HOOKS.

- (1) *Emergency-lift cable stretched.* Adjust cable length (par. 81c).
- (2) *Emergency-lift cable loose or damaged.* Adjust cable length (par. 81c), or install new cable (par. 81c).
- (3) *Oil trapped in upper part of hydraulic jack.* Remove the bleeder screw which is near the upper end of the hydraulic jack (fig. 54). Operate the hand-operated pump to raise the moldboard all the way up and to thus expel any oil that has seeped past the jack piston and has become trapped in the upper portion of the cylinder tube. While moldboard is fully elevated, install the bleeder screw.

Note. A recurrence of this trouble indicates a badly worn jack piston or cylinder. In such case replace jack (par. 80).

d. MOLDBOARD FAILS TO LOWER WHEN CARRYING HOOKS ARE DISENGAGED AND RELEASE VALVE IS OPEN.

- (1) *Release-valve lever loose* (fig. 45). Tighten lever.
- (2) *Clogged hydraulic line between hydraulic jack and hand-operated pump.* Remove the hose and connections, eliminate obstruction, and install the hose and connections (par. 84).

62. Carrying Hooks and Carrying-Hooks Cable

a. HOOKS FAIL TO ENGAGE PROPERLY.

- (1) *Hooks loose on shaft.* Inspect the two carrying hooks for security of their attachment to the carrying-hooks shaft. These hooks are secured by set screws which turn down into bores in the shaft (fig. 34). Relocate the positions of the carrying hooks, (par. 79c), and securely tighten the screws.

- (2) *Cable movement impeded.* Check the carrying-hooks cable for interference throughout its length (figs. 34 and 35). Remove any obstructions to cable movement.
- (3) *Cable slipping on drums.* Inspect the carrying-hooks-cable-drum block on the drum at the end of the carrying-hooks shaft (fig. 34), and also the block on the drum into which the control-lever shaft is threaded (fig. 35). Tighten the blocks.
- (4) *Cable stretched.* Adjust cable length (par. 28).
- (5) *Shaft or sheaves damaged.* Inspect the carrying-hooks-shaft assembly and cable sheaves (fig. 53) for distortion or damage. Replace carrying-hooks shaft (pars. 78 and 79), and/or sheaves (par. 77), as required.

b. HOOKS FAIL TO DISENGAGE PROPERLY; MOLDBOARD FAILS TO RAISE HIGH ENOUGH. If the carrying hooks can be engaged, but cannot be easily disengaged, probable cause is failure of moldboard to raise high enough (par. 60).

c. FAILURE OF EITHER HOOK TO ENGAGE OR DISENGAGE PROPERLY; HOOK LOOSE ON SHAFT. Position the loose hook on the shaft to correspond with the position of the hook which is working properly (fig. 34), then tighten the setscrew in the hook until it seats securely in the bore of the shaft.

Section V. MOLDBOARD CUTTING EDGE

63. Removal

a. Raise the moldboard (par. 38) to its extreme elevated position and engage the carrying hooks (par. 39).

b. Remove the 24 plow bolts, lock washers, and nuts (fig. 49) which attach the cutting edge to the moldboard. Lift the cutting edge from the moldboard, using a sling.

64. Installation

a. Raise the moldboard (par. 38) to its extreme elevated position and engage the carrying hooks (par. 39).

b. Position the cutting edge on the rear bottom of the moldboard, with the blade portion of the cutting edge down, and secure it in place with 24 plow bolts, lock washers, and nuts (fig. 49).

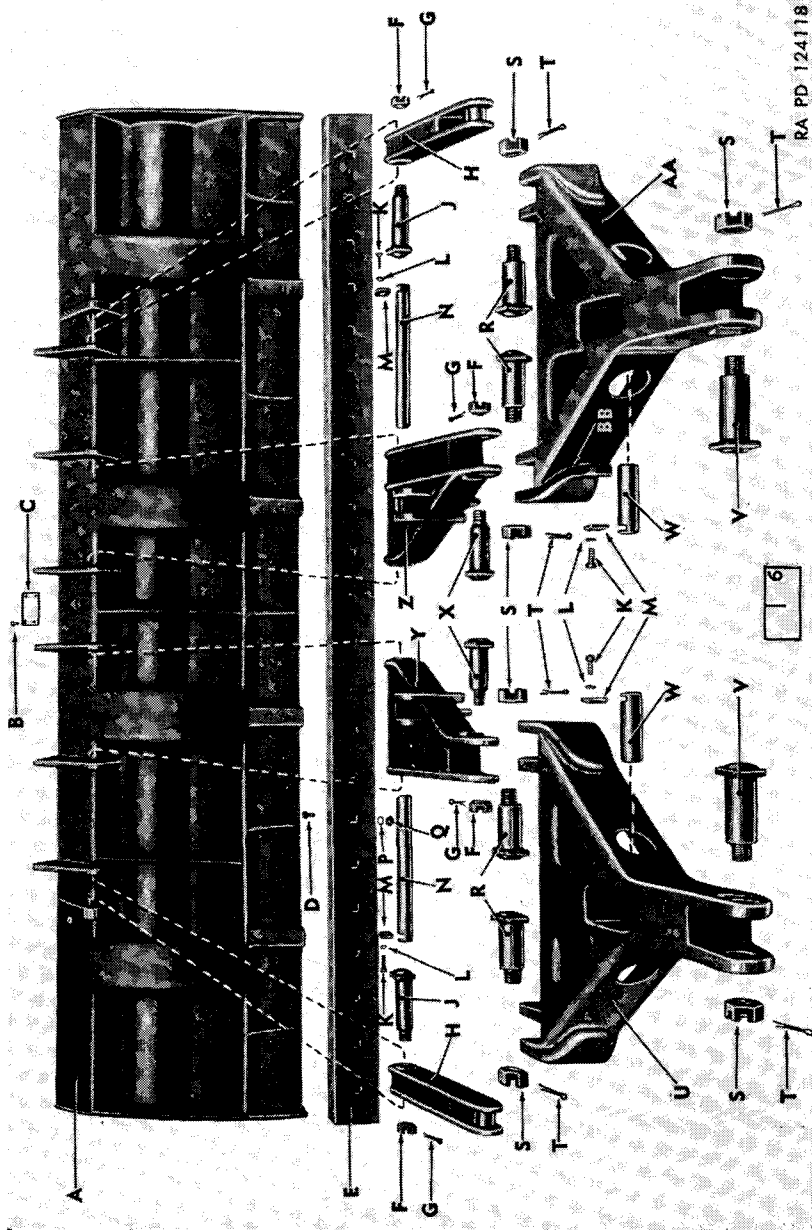


Figure 49. Moldboard, cutting edge, tilt arms, and push beams—exploded view.

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A—MOLDBOARD	Q— $\frac{3}{4}$ -10NC-2 NUT
B— $\frac{1}{2}$ -10-24NC-2 SCREW	R—MOLDBOARD-TO-P U S H-B E A M PIN
C—NAME PLATE	S— $1\frac{3}{4}$ -10NF-3 NUT
D— $\frac{3}{4}$ -10NC-2 x $2\frac{3}{4}$ PLOW BOLT	T— $\frac{3}{8}$ x $3\frac{1}{2}$ COTTER PIN
E—MOLDBOARD CUTTING EDGE	U—LEFT PUSH BEAM
F— $1\frac{1}{2}$ -12NF-3 NUT	V—PUSH-BEAM-TO-P U S H-B E A M- BRACKET PIN
G— $\frac{3}{8}$ x $2\frac{1}{2}$ COTTER PIN	W—P U S H - BEAM-TO-HYDRAULIC- CYLINDER-RAM PIVOT PIN
H—OUTER TILT ARM	X—INNER-TILT-A R M-TO-I N N E R- TILT-ARM-BRACKET PIN
J—MOLDBOARD-TO-O U T E R-TILT- ARM PIN	Y—LEFT-INNER TILT ARM
K— $\frac{5}{8}$ -18-3 x $1\frac{1}{4}$ SCREW	Z—RIGHT-INNER TILT ARM
L— $\frac{5}{8}$ -IN LOCK WASHER	AA—RIGHT PUSH BEAM
M—PIN LOCK	BB—CABLE-CONNECTOR BOSS
N—MOLDBOARD-TO-I N N E R-TILT- ARM PIN	
P— $\frac{3}{4}$ -IN LOCK WASHER	

Figure 49—Continued

Section VI. MOLDBOARD

65. Removal

a. Position the moldboard so that it is vertical with the bottom edge resting on the ground and move the control-valve-control operating lever to "FLOAT" position (par. 44).

b. Place an automotive-type jack under one push beam and raise the jack sufficiently to take the weight of the push beam off the two pins which attach this push beam to the moldboard (A, fig. 49).

c. Remove the cotter pin, nut, and one of the two pins (T, S, and R, fig. 49) which attach the push beam (V and AA, fig. 49) to the moldboard. Remove the cotter pin, nut, and other pin.

d. Lower the jack to allow the free end of the push beam to settle to the ground.

e. Detach the other push beam from the moldboard in like manner.

f. Start the vehicle engine (TM 9-718) and move the vehicle away from the moldboard until the top edge of the moldboard has rotated back and down as far as permitted by the linkage which connects the top edge of the moldboard to the vehicle.

g. Attach the sling of a hoist to any two symmetrically placed moldboard eyes and use the hoist to draw the sling taut. This will take the weight of the moldboard off the tilt arms attached to the top edge of the moldboard.

h. Remove the cotter pin, nut, and pin (G, F, and J, fig. 49), which attach the right-outer tilt arm (H, fig. 49) to the moldboard. Move the arm up and away from the moldboard and back against the vehicle hull.

i. Detach the left-outer tilt arm (H, fig. 49) from the moldboard in the same manner.

j. Remove the screw, lock washer, and pin lock (K, L, and M, fig. 49), then remove the long pin (N, fig. 49) which attaches the right-inner tilt arm (Z, fig. 49) to the top edge of the moldboard. Move the tilt arm up and away from the moldboard and back against the vehicle hull.

k. Detach the left-inner tilt arm (Y, fig. 49) from the moldboard in the same manner.

l. Move the vehicle completely away from the moldboard and use the hoist to move the moldboard wherever desired.

66. Installation

a. Move the moldboard into position in front of the vehicle, with the cutting edge resting on the ground and the moldboard held approximately vertical.

Note. Use a double sling for hoisting the moldboard, attaching the two hooks to any pair of symmetrically located moldboard eyes.

b. Place an automotive-type jack under one of the two push beams (fig. 49) and raise the beam up until the free end is approximately 12 inches above the ground (fig. 50).

c. Use the hoist to raise the moldboard high enough so that the pin bores at the front end of the push beam can be alined with the pin bores at the bottom back edge of the moldboard. Jockey the moldboard as necessary to aline the pin bores.

d. Insert the two $1\frac{3}{4}$ -inch-diameter pins which secure the push beam to the moldboard (fig. 49) and secure each pin with a $1\frac{3}{4}$ -inch nut and cotter pin.

Note. One pin attaches the right side of the push beam to the moldboard; the other pin attaches the left side. Each pin is inserted from the inner side of the push beam and thrust outward.

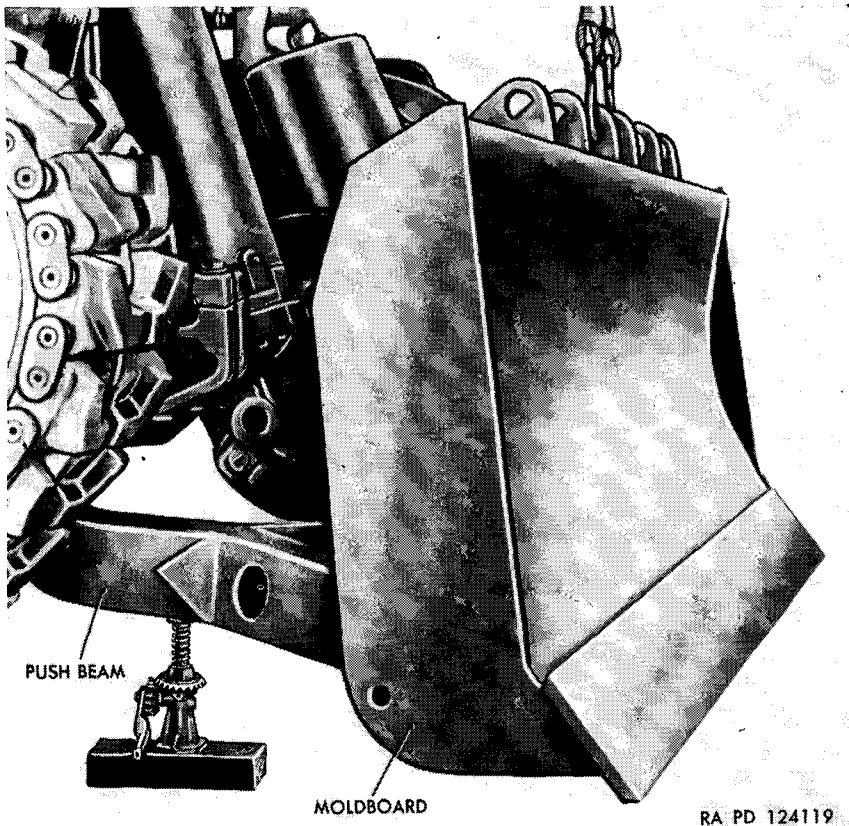
e. Attach the other push beam to the moldboard in the same manner.

f. Lower the moldboard until the bottom edge is resting on the ground, keeping the hoist sling taut and the moldboard standing in an approximate vertical position.

g. Move the right-outer tilt arm away from the vehicle hull until the free end of the tilt arm slides between the two bosses on the top edge of the moldboard and the pin bore in the tilt arm is alined with the pin bores in the bosses.

Note. It may be necessary to use the hoist to jockey the top edge of the moldboard in order to aline the pin bores.

h. Attach the tilt arm to the moldboard with a $1\frac{1}{2}$ -inch-diameter pin, $1\frac{1}{2}$ -inch nut, and cotter pin.



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Figure 50. Connecting push beam to moldboard.

Note. This pin is inserted from the inner side of the tilt arm and thrust outward.

i. Connect the remaining outer tilt arm to the moldboard in the same manner.

j. Remove the hoist sling from the moldboard.

k. Move the right-inner tilt arm away from the vehicle hull to engage the free end of this tilt arm between two of the bosses at the top edge of the moldboard, and aline the pin bore in the tilt arm with the pin bores in the bosses.

l. Connect the tilt arm to the moldboard, using a long pin, and secure this pin with a pin lock, lock washer, and screw.

Note. The pin is inserted at the outer side of the tilt arm and thrust toward the inner side.

m. Connect the remaining inner arm to the moldboard in the same manner.

Section VII. MOLDBOARD TILT ARMS AND PUSH BEAMS

67. Outer Tilt Arms

a. REMOVAL.

Note. Both outer tilt arms are removed in the same manner.

- (1) Position the moldboard so that it is approximately upright, with the bottom edge resting on the ground, and move the control-valve-control operating lever to "HOLD" position (par. 44).
- (2) Remove the cotter pin, nut, and pin which attach the outer tilt arm to the moldboard (fig. 49).
- (3) Remove two bolts and lock washers and remove the outer cap from the hydraulic-cylinder outer bracket which holds the tilt arm.
- (4) Remove the outer tilt arm.

b. INSTALLATION.

Note. Both outer tilt arms are installed in the same manner.

- (1) Position the end of the outer tilt arm (that end which contains the pin bore) between the two bosses at one end of the top edge of the moldboard (fig. 49), alining the pin bores in the bosses with the pin bore in the tilt arm. Attach the tilt arm to the moldboard with a pin, nut, and cotter pin.

Note. The pin is thrust from the inner side of the tilt arm toward the outer side.

- (2) Move the free end of the tilt arm to engage the pin formed at this end in the recess at the outer side of the hydraulic-cylinder outer bracket (fig. 18). Install the cap on the bracket, using two lock washers and long bolts.

Note. Be sure to install the proper cap on this bracket and to install the cap in the proper position, as indicated by the numbers cast in the front sides of the cap and bracket. Also, tighten the two bolts securely.

68. Inner Tilt Arms

a. REMOVAL.

Note. Steps (1) through (3) below only need be performed when the right-inner tilt arm is to be removed. If the left-inner tilt arm is to be removed, begin with step (4).

- (1) Remove the nut and pin which attach the clevis at the front (outside) end of the emergency-lift cable to the projecting boss at the left-front side of the right push beam (BB, fig. 49).

- (2) Remove two screws and lock washers and remove the emergency-lift-cable guard (fig. 39) from the top side of the right-inner tilt arm.
- (3) Pull the end of the emergency-lift cable up through the slot in the right-inner tilt arm to free the cable from the tilt arm.
- (4) Remove the cotter pin, nut, and pin to free the inner tilt arm from the tilt-arm bracket at the front of the vehicle.
- (5) Remove the screw, lock washer, pin lock, and long pin to free the inner tilt arm from the moldboard.
- (6) Remove inner tilt arm.

b. INSTALLATION.

Note. Both inner-tilt arms are installed in the same manner, except that the additional steps, (5) through (8), are necessary to complete installation of the right-inner tilt arm.

- (1) Position the wider portion of the tilt arm between the two bosses at the top edge of the moldboard, alining the pin bore in the tilt arm with the pin bores in the bosses.

Note. The right-inner tilt arm can be distinguished from the left-inner tilt arm by the fact that there are two downward projecting bosses (which hold the emergency-lift-cable sheave, figure 39) located on the under side of the right-inner tilt arm. Both tilt arms are installed with the carrying-hooks engagement pins (F, fig. 34) at top.

- (2) Attach the tilt arm to the moldboard with a long pin, pin lock, $\frac{5}{8}$ -inch lock washer and $\frac{5}{8}$ -inch cap screw (fig. 49).

Note. The long pin is inserted from the outer side of the tilt arm and thrust toward the inner side.

- (3) Move the free end of the tilt arm to engage the yoke formed at this end around the tilt-arm bracket at the front of the vehicle hull, alining the pin bores in the tilt arm with the pin bore in the bracket.
- (4) Attach the tilt arm to the bracket with a pin, nut, and cotter pin (fig. 17).

Note. The pin is inserted from the inner side of the tilt arm and thrust outward. Thrust the pin just far enough through the tilt-arm yokes to start a nut on the end of the pin, then tighten the nut to draw the pin the rest of the way through. If the pin is thrust all the way through at once, there will not be sufficient room between the pin end and the hydraulic-cylinder inner bracket (adjacent to the tilt-arm bracket) for insertion of the nut.

- (5) Thread the free end of the emergency-lift cable down through the slot in the right-inner tilt arm that is just to the outside of the carrying-hooks engagement pin (fig. 34).
- (6) Attach the clevis at the end of the emergency-lift cable to

- the boss (fig. 49) that projects backward from the left-front side of the right push beam, using the clevis pin and nut.
- (7) Install the emergency-lift-cable guard on the right-inner tilt arm (fig. 34) by inserting the small end of the guard down through the slot in the tilt arm at the inner side of the cable, and by securing the larger (top) member of the guard to the mounting pads on the tilt arm with two screws and lock washers.
 - (8) Fit the emergency-lift cable into the groove of the emergency-lift-cable shave that is installed on the under side of the right-inner tilt arm (fig. 39).

69. Push Beams

a. REMOVAL.

Note. Both push beams are removed in the same manner, except that step (2) is also necessary when removing the right push beam.

- (1) Detach the hydraulic-cylinder-piston-ram-end eye from the push beam by removing the screw, lock washer, pin lock, and pivot pin (fig. 19) which connect the eye to the center of the push beam.
- (2) If the right push beam is being removed, detach the emergency-lift cable from the boss that projects backward from the left-front side of this push beam (fig. 49), by removing the clevis pin and nut from the cable clevis.
- (3) Detach the push beam from the moldboard (par. 66 *b* through *e*).
- (4) Remove the cotter pin, nut, and pin which attach the push beam to the push-beam bracket at the front of the vehicle, and lower the push beam to the ground.

Note. As the push beam is very heavy, it will be advisable to use an automotive-type jack to hold the back end of the push beam level while removing the pin to detach the push beam from its bracket—and the jack can be used to lower the push beam onto rollers so that the beam can be rolled out from under the vehicle with ease.

b. INSTALLATION.

Note. Both push beams are installed in the same manner, except that step (10) is also necessary to complete installation of the right push beam.

- (1) Position the push beam, behind the moldboard and under the front of the vehicle, with the narrow portion of the beam to the rear, and the face having a rectangular opening (at the approximate center of the beam) on top.

Note. The right push beam can be distinguished from the left push beam by the fact that there is a backward projecting boss at the left-front side of the beam (fig. 49).

- (2) Attach a sling to the beam threading the sling through the circular opening at one side of the beam and out through the circular opening at the opposite side (fig. 50).
- (3) Use a hoist to raise the beam so that the yoke at the rear end of the beam is in position around the push-beam bracket.

Note. It will be advisable to have two operators under the front end of the vehicle to guide the push beam into position.

- (4) Aline the pin holes at the rear end of the beam with the pin bore in the push-beam bracket. Connect the push beam to the bracket with a pin, nut, and cotter pin.

Note. The pin is thrust from the inner side toward the outer side.

- (5) Start the vehicle engine (TM 9-718), then use the hoist to raise the front end of the beam and, simultaneously, inch the vehicle forward to engage the two yokes formed at the front end of the beam around the bosses at the bottom-rear edge of the moldboard. Jockey the beam as necessary to aline the pin holes in the beam with the pin holes in the bosses.
- (6) Connect the beam to the moldboard with two pins, nuts, and cotter pins.

Note. Each pin is thrust from the inner side of the push beam toward the outer side.

- (7) Detach the sling from the push beam.
- (8) Insert a crowbar through the eye at the end of the hydraulic-cylinder-piston ram, and use the crowbar to force the ram down (out of the cylinder) until the end of the ram is just above the rectangular opening at the top center of the push beam. Remove the crowbar.
- (9) Attach a sling to one of the bosses at the top edge of the moldboard, passing the sling through the eye of the boss. Use the hoist to raise the moldboard until the eye at the end of the hydraulic-cylinder-piston ram is inside the rectangular opening in the top center of the push beam. Simultaneously, use the crowbar to pry the top end of the cylinder away from the vehicle hull, to rotate the ram end and move the eye backward and forward. Thus using the hoist and crowbar, aline the ram-end eye with the pin bores in the sides of the push beam, and attach the ram to the push beam with the pivot pin, pin lock, lock washer, and screw (fig. 19).

Note. The pin is thrust from the outer side of the push beam through to the inner side by utilizing the circular opening at the outer side of the push beam. The pin lock can be installed by reaching in through the circular opening at the inner side of the push beam. If the right push beam is being installed, the following additional step is necessary.

- (10) Connect the front (outer) end of the emergency-lift cable

to the boss that projects from the left-front side of the right push beam, using the clevis pin and nut. Place the cable in the groove of the small emergency-lift-cable sheave that is installed on the under side of the right-inner tilt arm (fig. 39).

Section VIII. HYDRAULIC-CYLINDER AND HYDRAULIC-LINE GUARDS AND GUARD PLATES

Note. The hydraulic-cylinder and hydraulic-line guards and guard plates can be removed with the moldboard attached to the vehicle. The moldboard should be in an approximately vertical position with the bottom edge resting on the ground, and the control-valve-control operating lever moved to the "HOLD" position (par. 45).

70. Hydraulic-Cylinder Guards

Note. Both guards are removed and installed in the same manner.

a. REMOVAL.

- (1) Remove the three screws and lock washers which attach the bottom portion of the guard (fig. 51) to the hydraulic cylinder.
- (2) Attach a sling to the handle formed at the top of the guard, and raise the guard straight up and away from the hydraulic cylinder.

b. INSTALLATION.

- (1) Attach a sling to the handle at the top of the guard, and lower the guard into position over the hydraulic cylinder.

Note. When properly installed, each guard has the open portion against the vehicle hull and the cylindrical bulge, that is at one side of the guard, facing the center line of the vehicle. When lowering the guard over the hydraulic cylinder, be careful not to damage the hydraulic lines connected to the cylinder. Also, lower the guard slowly so as to align the three bolt holes in the guard properly with the bolt holes in the lugs that are welded to the hydraulic cylinder.

- (2) Secure the guard to the hydraulic cylinder with three screws and lock washers (figs. 13 and 51).

71. Hydraulic-Piping Upper Guard

a. REMOVAL.

- (1) Remove two screws and lock washers (fig. 51) which secure the upper guard to hydraulic-piping lower guard (fig. 15).
- (2) Remove three screws and lock washers which attach the guard to the three mounting blocks welded to the front of the vehicle hull, and lift the guard away from the hull.

b. MAINTENANCE. Using soap and water, clean the surfaces of the five pieces of rubber seal (fig. 51), which are used to seal the guard to the front of the vehicle hull. These rubber seals are mounted in grooves in the back edge of the guard, and can be remounted by stuffing the narrow parts of the seals into the grooves. Replace any seal that is damaged with a new seal.

c. INSTALLATION.

- (1) Position the guard (fig. 51) against the vehicle hull, and aline the three mounting lugs on the guard with the mounting blocks welded to the vehicle hull.
- (2) Secure the guard mounting blocks with three screws and lock washers.
- (3) Secure the upper guard to the hydraulic-piping lower guard with two screws and lock washers (fig. 15).

72. Hydraulic-Piping Lower Guard

a. REMOVAL.

- (1) Remove the hydraulic-piping upper guard (par. 71).
- (2) Detach the two inner tilt arms from the vehicle hull (par. 68) and move them out of the way (fig. 39).
- (3) Attach a sling to the handle at the top center of the guard, and raise until the sling is taut.
- (4) Remove three screws and lock washers (fig. 14) which attach the lower guard to the mounting blocks welded to the vehicle hull (fig. 14).
- (5) Remove four screws and lock washers (fig. 51) which attach the guard to the mounting blocks welded to the hydraulic-piping-center guard plate, and lift the guard free of the vehicle.

Note. To lift the guard free of the vehicle, first lower it (by means of the sling) several inches, while at the same time pulling it straight away from the vehicle to disengage the guard from around the left-inner-tilt-arm bracket—then lift it way from the vehicle.

b. INSTALLATION.

- (1) Attach a sling to the handle formed at the top of the guard (fig. 51), and lower the guard into position on the front of the vehicle with the slot cut into the flat top of the guard near the right end approximately in front of the lower part of the left-inner-tilt-arm bracket.
- (2) Push the guard straight against the vehicle, engaging the slot around the bottom portion of the left-inner-tilt-arm bracket, and positioning the edges of the guard against the mounting blocks (fig. 14).

Note. It may be necessary to jockey the guard in order to position it properly against the mounting pads.

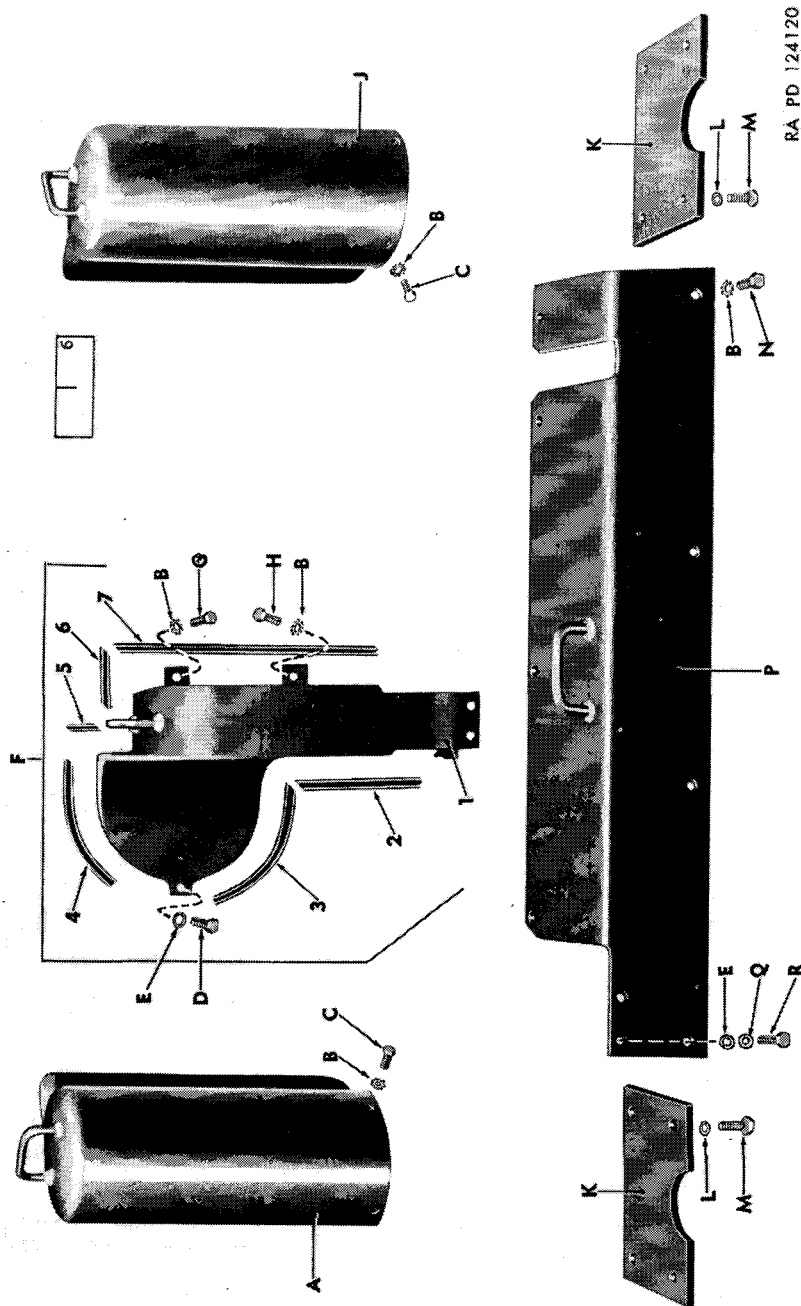


Figure 51. Hydraulic-cylinder and piping guards and guard plates.

A—RIGHT HYDRAULIC-CYLINDER GUARD	6—5-1/2-IN UPPER GUARD SEAL
B—1/2-IN LOCK WASHER	7—19-1/2-IN UPPER GUARD SEAL
C—1/2-20NF-3 x 1 1/4 SCREW	G—1/2-20NF-2 x 1 1/2 SCREW
D—1/2-13NC-2 x 1 1/8 BOLT	H—1/2-20NF-2 x 1 SCREW
E—1/2-IN LOCK WASHER	J—LEFT-HYDRAULIC-CYLINDER GUARD
F—PIPING UPPER GUARD ASSEMBLY	K—PIPING END GUARD PLATE
1 - PIPING UPPER GUARD	L—3/8-IN LOCK WASHER
2-9-3/4-IN UPPER GUARD SEAL	M—3/8-24NF-2 x 1 1/4 SCREW
3-12-1/4-IN UPPER GUARD SEAL	N—1/2-20NF-2 x 1 1/4 SCREW
4-12-1 1/16-IN UPPER GUARD SEAL	P—PIPING LOWER GUARD
5-3-5/8-IN UPPER GUARD SEAL	Q—9/16-IN PLAIN WASHER
	R—1/2-20NF-2 x 1 3/4 SCREW

Figure 51.—Continued

- (3) Install four screws and lock washers (figs. 14 and 51) which secure the guard to the mounting pads welded to the hydraulic-piping-center guard plate.
- (4) Install the three screws and lock washers which secure the guard to the mounting pads welded to the front of the vehicle hull.
- (5) Install the hydraulic-piping upper guard (par. 71).
- (6) Attach the two inner tilt arms to the inner-tilt-arm brackets at the front of the vehicle hull (par. 68).

73. Hydraulic-Piping End Guard Plates

Note. Both plates are removed and installed in the same manner.

a. REMOVAL.

- (1) Remove four screws and lock washers which attach the plate (figs. 11 and 51) to the mounting pads welded to the hydraulic-cylinder inner and outer brackets.
- (2) Remove the plate from the mounting pads.

b. INSTALLATION.

- (1) Position the plate (figs. 11 and 51) up against the four mounting pads welded to the hydraulic-cylinder inner and outer brackets, alining the bolt holes in the plate with the bolt holes in the pads.

Note. The plate is properly installed when the edge with the cut-out portion is to the front.

- (2) Secure the plate to the mounting pads with four screws and lock washers.

Section IX. HYDRAULIC CYLINDERS AND EXTERIOR HYDRAULIC LINES

74. Hydraulic Cylinders

Note. Both hydraulic cylinders are removed and installed in the same manner.

a. REMOVAL.

- (1) Position the moldboard so that it is approximately vertical, with the bottom edge resting on the ground, and move the control-valve-control operating lever to "HOLD" position (par. 44).

Note. Drain hydraulic system (par. 97).

- (2) Detach the hydraulic-cylinder-piston-ram eye from the push beam by removing the screw, lock washer, pin lock, and pivot pin (figs. 19 and 49).
- (3) Remove the hydraulic-piping end guard plate (par. 73).
- (4) Disconnect the upper end right-hydraulic cylinder to upper end left-hydraulic-cylinder rubber hose (fig. 13) from the hydraulic-cylinder upper end rubber hose by breaking the connection between these two hoses (fig. 52).

Note. The right-hydraulic-cylinder fittings are not actually connected to the hoses named in steps (4) and (5); there is a nipple and a female-tee-adapter union (fig. 52) in each hydraulic line between the horizontal hoses and the right-hydraulic-cylinder fittings.

- (5) Disconnect the lower-end-right-hydraulic-cylinder-to-lower-end-left-hydraulic-cylinder rubber hose (fig. 13) from the hydraulic cylinder by breaking the connection at the elbow adapter union (fig. 52) installed in the hydraulic cylinder.
- (6) Remove the two bolts and lock washers and remove the cap from the hydraulic-cylinder inner bracket (fig. 13).
- (7) Remove the two long bolts and lock washers and remove the inner cap from the hydraulic-cylinder outer bracket (fig. 13).
- (8) Attach a sling to the handle at the top of the hydraulic-cylinder guard, and lift the guard, with the cylinder attached, straight up and from the vehicle.

Caution: Be careful not to let the cylinder swing against the vehicle hull and damage any of the hydraulic-line fittings.

- (9) Remove three screws and lock washers and remove the guard from the cylinder (fig. 51).
- (10) Remove the hose and elbow adapter union from the top end of the hydraulic cylinder by turning the union out of its bore in the cylinder. Also, remove the elbow adapter union installed in the bottom of the cylinder.

7. INSTALLATION.

- (1) Install the hydraulic-cylinder-upper-end rubber hose (fig. 13), and the elbow adapter union in the hydraulic cylinder by turning the union into the threaded bore near the top of the cylinder. Position the union so that the hose points straight toward the bottom of the cylinder. Install the elbow adapter union (fig. 52) in the threaded bore at the bottom of the cylinder. Position the union to point toward the center line of the vehicle when the cylinder is installed.
- (2) Position the hydraulic-cylinder guard (fig. 51) over the cylinder and secure it to the cylinder with three screws and lock washers.

Note. The right hydraulic cylinder is the cylinder which has the hydraulic-line fittings installed at the side facing the center line of the vehicle when the cylinder is installed on the vehicle, and the right-hydraulic-cylinder guard is the guard which will fit onto this cylinder with the open portion of the guard towards the vehicle hull.

- (3) Attach a sling to the handle at the top of the guard and raise the guard, with the cylinder attached, into approximate mounting position so that it is suspended above the two cylinder mounting brackets. Slowly lower the guard and cylinder straight into place on the front of the vehicle with the stub shafts (near the bottom of the cylinder) resting in the two cylinder brackets.

Caution: While lowering the cylinder into place, be careful not to crush any of the hydraulic-line fittings.

- (4) Install the cap on the hydraulic-cylinder inner bracket. Install the inner cap on the hydraulic-cylinder outer bracket. Secure each cap in place with two long bolts and lock washers.

Note. Be sure to install caps on the proper brackets and in the proper positions, in accordance with the numbers cast into the faces of the caps and brackets. Tighten the bolts securely.

- (5) Connect the hydraulic-cylinder-upper-end rubber hose to the upper-end-right-hydraulic-cylinder-to-upper-end-left hydraulic-cylinder rubber hose (fig. 13), making the connection at the elbow adapter union which connects these two hoses (fig. 52).

Note. The right-hydraulic-cylinder fittings are not actually connected to the hoses named in steps (5) and (6); there is a nipple and a tee adapter union (fig. 52) in each hydraulic line between the horizontal hoses and the right-hydraulic-cylinder fittings.

- (6) Connect the lower-end-right-hydraulic-cylinder-to-lower-end-left-hydraulic-cylinder rubber hose (fig. 13) to the elbow

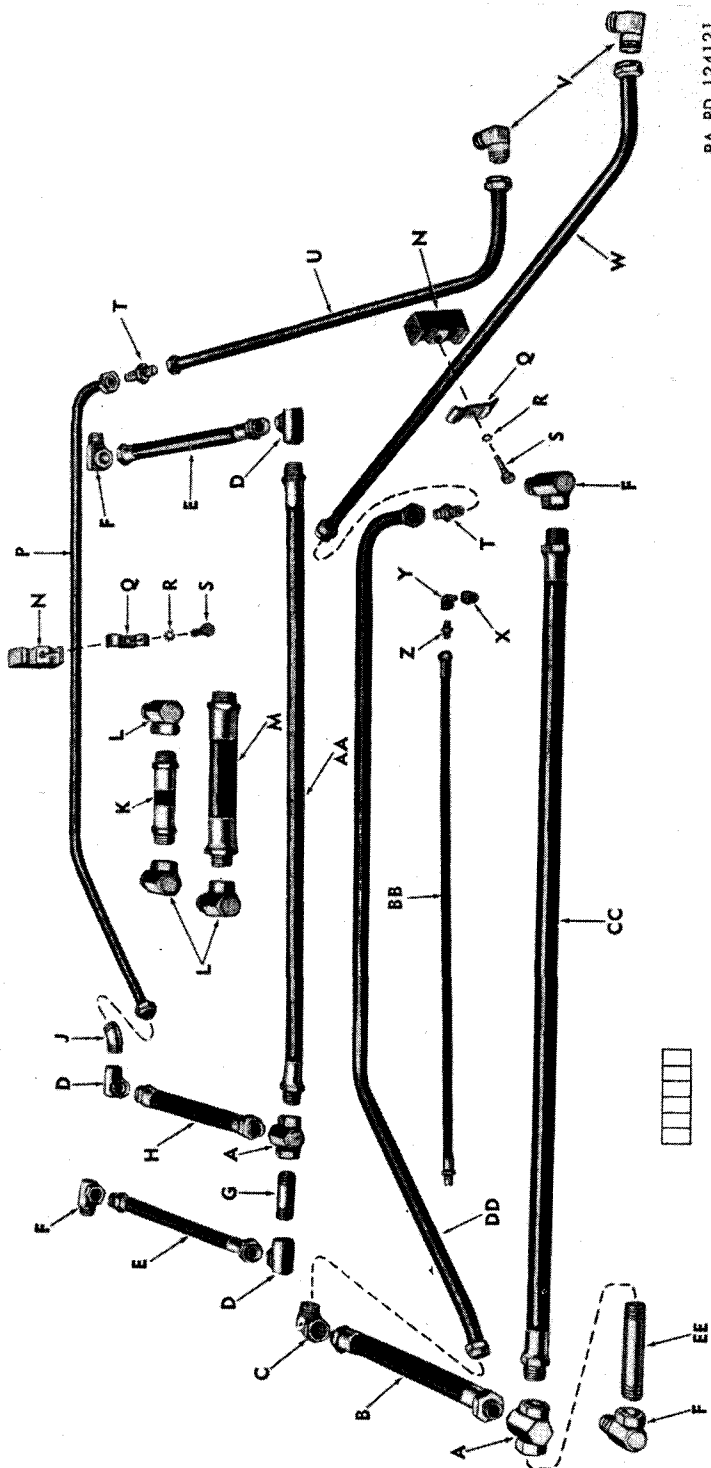


Figure 52. Arrangement of hydraulic lines and fittings.

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A—FEMALE-TEE-ADAPTER UNION
 B—HYDRAULIC-CYLINDER-TO-UPPER-FRONT-LINE HOSE (UPPER END)
 C—90-DEG, 1-IN ELBOW
 D—RIGHT-ANGLE-FEMALE-ADAPTER UNION
 E—HYDRAULIC-CYLINDER-UPPER-END RUBBER HOSE (RIGHT AND LEFT)
 F—RIGHT-ANGLE-MALE-ADAPTER UNION
 G—1-IN PIPE NIPPLE
 H—HYDRAULIC-CYLINDER-TO-UPPER-FRONT-LINE HOSE (LOWER END)
 J—45-DEG, 1-IN ELBOW
 K—HYDRAULIC-PUMP-TO-CONTROL-VALVE RUBBER HOSE
 L—1¼-IN RIGHT-ANGLE-MALE-ADAPTER UNION
 M—HYDRAULIC-PUMP-TO-OIL-RESERVOIR RUBBER HOSE
 N—HYDRAULIC-CYLINDER-TO-CONTROL-VALVE-LINE MOUNTING BLOCK
 P—HYDRAULIC-CYLINDER-TO-CONTROL-VALVE-LOWER-FRONT LINE
 Q—HYDRAULIC-CYLINDER-TO-CONTROL-VALVE-LINE MOUNTING BLOCK CLAMP
 R—½-IN LOCK WASHER
 S—½-20NF-2 x 1¼ SCREW
 T—1-IN-SAFETY-SLEEVE TUBE UNION
 U—HYDRAULIC-CYLINDER-TO-CONTROL-VALVE-LOWER-REAR LINE
 V—90-DEG, 1-IN ELBOW
 W—HYDRAULIC-CYLINDER-TO-CONTROL-VALVE-UPPER REAR LINE
 X—½ x ¼-IN BUSHING
 Y—90°, ¼-IN ELBOW
 Z—HYDRAULIC-JACK-INLET-HOSE-TO-ELBOW ADAPTER
 AA—UPPER-END-RIGHT-HYDRAULIC-CYLINDER-TO-UPPER-END - LEFT-HYDRAULIC-CYLINDER HOSE
 BB—HAND-OPERATED-PUMP-TO-HYDRAULIC-JACK RUBBER HOSE
 CC—LOWER-END-RIGHT-HYDRAULIC-CYLINDER-TO-LOWER-END-LEFT-HYDRAULIC-CYLINDER RUBBER HOSE
 D—HYDRAULIC-CYLINDER-TO-CONTROL-VALVE-FRONT-UPPER LINE
 EE—6½-IN NIPPLE

Figure 52.—Continued

adapter union (fig. 52) installed in the lower end of the cylinder.

- (7) Install the hydraulic-piping end guard plate (par. 73).
- (8) Attach the hydraulic-cylinder-piston-ram eye to the push beam (par. 69 *b* (9)).

75. Exterior Hydraulic Lines and Fittings

a. REMOVAL.

- (1) Remove the hydraulic-piping upper guard (par. 71).
- (2) Remove the hydraulic-piping lower guard (par. 72).
- (3) Disconnect the two tee adapter unions (fig. 52) from the horizontal lines by disconnecting them from the nipples at their right ends, and from the two hoses at their left ends.
- (4) Remove the lower-end-hydraulic-cylinder-to-upper-front-line rubber hose (fig. 13) by disconnecting it from the elbow

adapter union at the top end of the hose. Remove the tee adapter union from the bottom end of the hose. Remove the elbow adapter union from the elbow on the line that protrudes out the front of the vehicle.

- (5) Remove the upper-end-hydraulic-cylinder-to-lower-front-line rubber hose (fig. 13) in the same manner.

Note. The top end of this hose is connected to the line which protrudes through the front of the hull by a compression elbow (fig. 52) instead of an adapter union.

- (6) Remove the two hydraulic-piping end guard plates (par. 73).
- (7) Remove the lower-end-right-hydraulic-cylinder-to-lower-end-left-hydraulic-cylinder rubber hose (fig. 13) by disconnecting it from the elbow adapter union (fig. 52) installed in the bottom of the left hydraulic cylinder. Remove the union from the cylinder.
- (8) Remove the upper-end-right-hydraulic-cylinder-to-upper-end-left-hydraulic-cylinder rubber hose (fig. 13) by disconnecting it from the left-hydraulic-cylinder-upper-end rubber hose at the elbow adapter union (fig. 52) which connects these two hoses.
- (9) Remove the nipple (fig. 52) connected to the elbow adapter union installed in the bottom of the right hydraulic cylinder. Remove the union from the cylinder.
- (10) Remove the pipe nipple (fig. 52) and the elbow adapter union that are at the bottom end of the right-hydraulic-cylinder-upper-end rubber hose, and separate these two parts.
- (11) Remove the two hydraulic-cylinder guards (par. 70).
- (12) Remove the left-hydraulic-cylinder-upper-end rubber hose (fig. 13), and the elbow adapter union (fig. 52) at the bottom end of this hose, by disconnecting the hose from the elbow adapter union installed in the hydraulic cylinder near the top. Remove the adapter union from the cylinder and the adapter union from the hose.
- (13) Remove the right-hydraulic-cylinder-upper-end rubber hose in the same manner.

Note. The union at the bottom of the hose is already removed, step (10).

b. MAINTENANCE. Thoroughly wash all rubber hoses with soap and water. Clean the threads of the hose fittings and all adapter unions and the nipples with dry-cleaning solvent or volatile mineral spirits paint thinner.

c. INSTALLATION.

- (1) Install an elbow adapter union (fig. 52) in the threaded bore near the top of the left hydraulic cylinder. Connect the left-

hydraulic-cylinder-upper-end rubber hose (fig. 13) to the union.

- (2) Install an elbow adapter union (fig. 52) and the right-hydraulic-cylinder-upper-end rubber hose (fig. 13) in the right hydraulic cylinder, in the same manner.
- (3) Install the two hydraulic cylinder guards (par. 70).
- (4) Install the pipe nipple (fig. 52) in an elbow adapter union. Connect the union to the bottom end of the right-hydraulic-cylinder-upper-end rubber hose. Tighten the union on the hose so that the nipple lies horizontally across the front of the vehicle.
- (5) Install an elbow adapter union in the threaded bore at the bottom of the right hydraulic cylinder. Install a nipple (fig. 52) in the union, arranging the union so that the nipple lies horizontally across the front of the vehicle.
- (6) Install an elbow adapter union (fig. 52) in the threaded bore at the bottom of the left hydraulic cylinder.
- (7) Install the two hydraulic-piping end guard plates (par. 73).
- (8) Install the elbow at the end of the bottom one of the two hydraulic lines that protrude through the front of the hull, connect an elbow adapter union to the elbow—and tighten these parts so that the union points straight down.
- (9) Connect the upper-end-hydraulic-cylinder to the lower-front-line rubber hose (fig. 13) to a tee adapter union (fig. 52), then connect the free (upper) end of this hose to the adapter union just installed ((8) above). Tighten the fittings so that the tee lies horizontally across the front of the vehicle.
- (10) Install the compression elbow (fig. 52) at the end of the remaining hydraulic line that protrudes through the front of the hull, tightening the elbow so that it points straight down.
- (11) Connect the lower-end-hydraulic-cylinder to upper-front-line rubber hose (fig. 13) to the second tee adapter union (fig. 52), then connect the free (upper) end of this hose to the elbow just installed ((10) above). Tighten the fittings so that the tee lies horizontally across the front of the vehicle.
- (12) Position the upper-end-right-hydraulic-cylinder to upper-end-left-hydraulic-cylinder rubber hose (fig. 13) at the front of the vehicle with the ends inserted through the openings in the respective inner-tilt-arm brackets—then connect the right end of this hose to the tee adapter union that is at the bottom end of the upper-end-hydraulic-cylinder to lower-front-line rubber hose. Connect the tee to the pipe nipple that is already connected to the right hydraulic cylinder ((4)

above). Connect an elbow adapter union (fig. 52) to the free end of the horizontal hose. Connect this union to the free (lower) end of the left-hydraulic-cylinder-upper-end rubber hose (fig. 13).

- (13) Position the lower-end-right-hydraulic-cylinder-to-lower-end-left-hydraulic-cylinder rubber hose (fig. 13) at the front of the vehicle with the ends inserted through the openings in the respective inner-tilt-arm brackets. Connect the right end of this hose to the remaining tee adapter union (at lower end of the lower-end-hydraulic-to-upper-front-line-rubber hose). Connect the tee to the nipple that is already connected to the bottom end of the right hydraulic cylinder ((5) above). Connect the left end of the hose to the union already installed in the bottom of the left hydraulic cylinder ((6) above).
- (14) Install the hydraulic-piping-lower guard (par. 72).
- (15) Install the hydraulic-piping-upper guard (par. 71).

Section X. CARRYING-HOOKS CABLE AND CABLE SHEAVES

76. Carrying-Hooks Cable

a. REMOVAL.

- (1) Disconnect the carrying-hooks-cable ends at the carrying-hooks-cable turnbuckle by removing the nut and pin from the carrying-hooks-cable-end connector at the top side of the turnbuckle (fig. 36).
- (2) Remove the cable-end connector (disconnected from the turnbuckle) by unscrewing the cable-end sleeve out of the clevis. Remove the pointed plug, and pull the cable end out of the sleeve.
- (3) From the inside of the vehicle, pull the free end of the cable (from which the cable end has been removed) through the carrying-hooks-upper-sheave bracket (on exterior of hull) and down through the carrying-hooks-lower-sheave bracket (inside the hull). The plain end of the cable will now be inside the vehicle.
- (4) Remove the carrying-hooks operating lever by loosening the nut at the base of the shaft and removing the shaft and the carrying-hooks-cable-drum block (which is secured to the drum by the shaft) (fig. 53).
- (5) Unwind the cable from the cable drum (inside the vehicle).
- (6) From outside the vehicle, pull the portion of cable remaining inside the vehicle out through the lower and upper sheave brackets.

- (7) Remove the screw, lock washer, and cable-drum block attached to the carrying-hooks-cable-drum body (at the front of the vehicle).
- (8) Unwind the cable from the drum body and remove cable from the vehicle.

b. MAINTENANCE. Inspect the end of the cable removed from the cable-end connector to make certain that the strand ends are not bent or damaged. Inasmuch as there is relatively little adjustment provided for in the cable (allowable adjustment is limited by the turnbuckle), damaged cable ends cannot be cut back more than 2 or 3 inches to provide a new undamaged end for installation of the cable-end connector. If there is need to cut the cable back farther than this, or the cable has already been cut back as far as permissible, or if it is damaged at other portions, the cable must be replaced.

c. INSTALLATION.

- (1) Wrap the end of the cable holding the turnbuckle one and one-half times around the carrying-hooks-cable-drum-body at the front of the vehicle, with the turnbuckle end emerging at the rear of the drum (next to the vehicle hull) and extending upward so that the top end of the turnbuckle is approximately two-thirds of the way up between the drum and the carrying-hooks-cable-guide sheave (fig. 36).
- (2) Without changing the position of the cable, rotate the drum (slipping it inside of cable loop if necessary) to position the cable-drum block on the top, and as far back against the hull as possible. Install the cable-drum block with a screw and lock washer. Insert the screw between the two loops of the cable when installing the block; and tighten the screw securely.
- (3) Carry the plain end of the cable upward along the hull over one of the two sheaves in the carrying-hooks-cable-guide-sheave support. Thread it into the bottom of the carrying-hooks-upper-sheave bracket (over one of the two sheaves in the bracket), then down into the vehicle over one of the two sheaves in the lower bracket (select the sheave that is at the same side of the vehicle as the sheave in the upper bracket over which the cable has been passed), and out the opening at the bottom of the lower bracket (fig. 35).
- (4) Wrap the cable one and one-half turns around the cable drum (at the bottom of the carrying-hooks-lower-sheave bracket), then pass it back up through the bracket and out the front of the upper bracket. Place cable over the remaining sheaves in the respective brackets.
- (5) Wrap the plain end of the cable with wire for a distance of

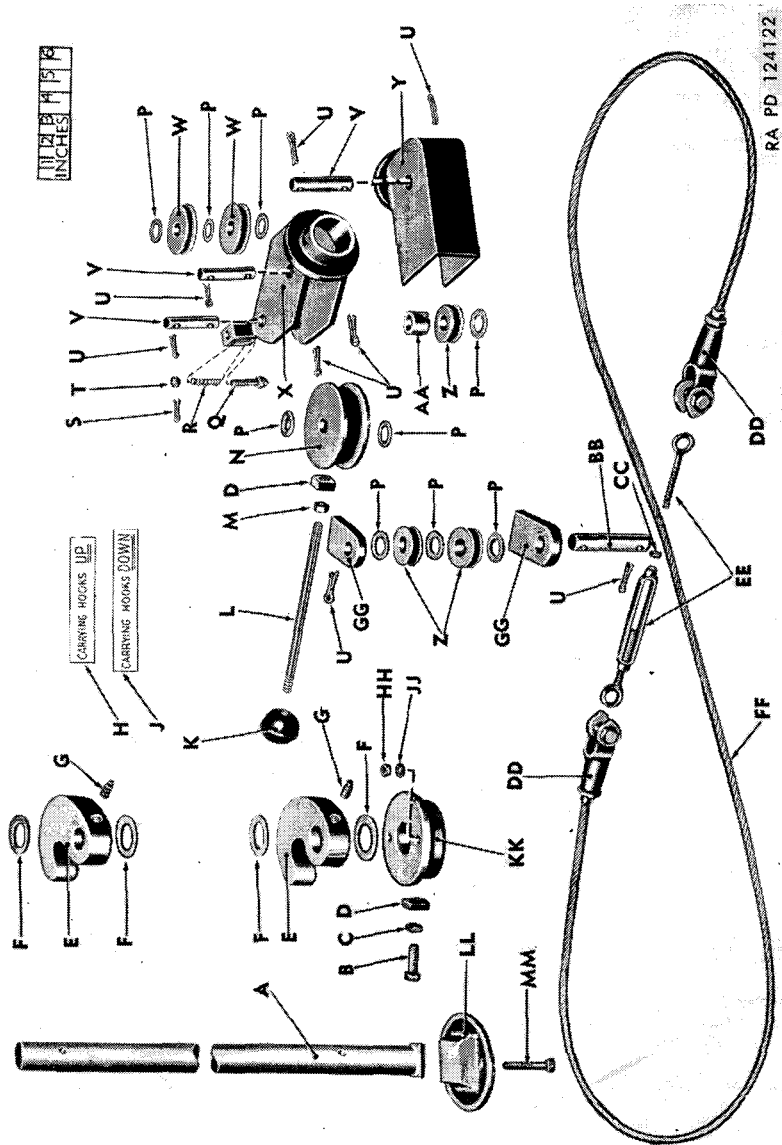


Figure 53. Carrying-hooks shaft, cable, cable drums, cable sheaves and brackets, and operating lever—exploded view.

A—CARRYING-HOOKS SHAFT	V— $\frac{3}{4}$ x 2.3-IN HEADLESS PIN
B— $\frac{1}{2}$ -20NF-3 x $1\frac{3}{4}$ SCREW	W—3-IN CABLE SHEAVE
C— $\frac{1}{2}$ -IN LOCK WASHER	X—SHEAVE UPPER BRACKET
D—CABLE-DRUM BLOCK	Y—SHEAVE LOWER BRACKET
E—CARRYING HOOK	Z—CARRYING HOOKS CABLE
F—CARRYING-HOOKS SPACER	SHEAVE
G— $\frac{1}{2}$ -20NF-3 x 1 SET SCREW	AA—UPPER-BRACKET SHEAVE
H—CARRYING HOOKS UP IN- STRUCTION DECAL	SPACER
J—CARRYING HOOKS DOWN IN- STRUCTION DECAL	BB— $\frac{3}{4}$ x 2.8-IN HEADLESS PIN
K—OPERATING-LEVER KNOB	CC— $\frac{1}{4}$ -20NC-3 NUT
L—OPERATING-LEVER SHAFT	DD—CABLE END
M— $\frac{1}{2}$ -20NC-3 NUT	EE—CABLE TURNBUCKLE
N—CABLE DRUM	FF—CARRYING-HOOKS CABLE
P— $\frac{1}{16}$ -IN PLAIN WASHER	GG—CABLE-GUIDE-SHEAVE PIN
Q—CABLE-DRUM PIN	SUPPORT
R—SPRING	HH— $\frac{3}{8}$ -24NF-3 NUT
S— $\frac{3}{32}$ x 1-IN COTTER PIN	JJ— $\frac{3}{8}$ -IN LOCK WASHER
T— $\frac{3}{8}$ -24NF-2 NUT	KK—CABLE-DRUM BODY
U— $\frac{5}{32}$ x $1\frac{1}{4}$ -IN COTTER PIN	LL—CABLE-DRUM-BODY PLATE
	MM— $\frac{3}{8}$ -24NF-3 x 2 SCREW

Figure 53—Continued

one-fourth inch, in two places located approximately one-half inch and 3 inches from the cable end.

Note. If the cable end has not been cut off, the second wire wrap will be there.

- (6) Push the sleeve of the cable-end connector (fig. 53), plain end first, over the cable end far enough to prevent the cable from fanning out. Remove the first wire wrap. Insert a screwdriver blade into the center of the cable strands to spread them, pry out the hemp center and cut it off just below the second wire wrap (if not already cut off).
- (7) Push the cable-end sleeve down over the cable far enough to insert the pointed plug among the cable strands. Alternately tap the sleeve and the plug to drive them onto the cable, until the lower end of the sleeve is approximately $2\frac{3}{8}$ inches from the end of the cable. Drive the plug in so that it seats solidly. Compress the protruding cable strands as necessary, and screw the clevis tightly back onto the cable-end sleeve.
- (8) Adjust the carrying-hooks-cable turnbuckle so that the cable will be slack. Attach the free cable-end connector to the turnbuckle with a pin and nut.
- (9) Place the two cable strands that are at the front of the vehicle over the two sheaves (fig. 36) in the carrying-hooks-cable-guide sheave support.
- (10) Rotate the carrying-hooks shaft to place the carrying-hooks

up (rear sides of hooks will touch the vehicle hull). Install the cable-drum block on the drum inside the vehicle by inserting the carrying-hooks operating lever through the block and screwing it into the drum between the two loops of the cable around the drum. Do not tighten the nut at the base of the lever at this time.

- (11) Rotate the cable drum inside the vehicle (drum can be slipped inside of cable loops if necessary) to move the knob end of the lever as far forward as it will go.

Note. Do not move the cable.

- (12) Take all slack out of the cable by drawing the turnbuckle up tight. Secure the turnbuckle by tightening the lock nuts at each end.
- (13) While keeping the carrying-hooks shaft with the hooks up ((10) above) and the operating lever with the knob end forward ((11) above), tighten the nut at the base of the operating lever down against the cable-drum block to secure the cable to the drum.

77. Cable Sheaves

a. REMOVAL.

- (1) Remove the cotter pin from either end of the headless pin installed in the carrying-hooks-cable-guide-sheave support (fig. 53), and pull the pin from the support, thus freeing the two cable sheaves and three plain washers installed in the support.
- (2) Remove the carrying-hooks cable (par. 76).
- (3) Remove the cotter pin from either end of the headless pin installed in the carrying-hooks-sheave upper bracket (fig. 53), and pull the pin out of the bracket, thus freeing the carrying-hooks-upper-bracket-sheave spacer, one cable sheave, and one plain washer.
- (4) Pull the cotter pin from either end of the headless pin that holds the carrying-hooks-cable drum into the carrying-hooks-sheave lower bracket (figs. 35 and 53), and remove the pin from the bracket, thus freeing the cable drum and two plain washers.

Note. When the drum is removed, the cable-drum-carrying-hooks pin will be pushed downward in the bracket by its helical spring.

To remove this pin, remove the cotter pin and nut from the outer end of the pin, push the pin down and out through the inside of the bracket, and lift the helical spring out of the enclosure welded to the side of the bracket (fig. 53).

- (5) Remove the cotter pin from either end of the headless pin remaining in the carrying-hook-sheave lower bracket (fig. 53) and remove the pin, thus freeing two cable sheaves and three plain washers.

b. MAINTENANCE. Inspect the headless pins for deep scratches and worn spots which would interfere with rotation of the sheaves which they support. Inspect the flanges of the sheaves for rough or worn spots which would damage the carrying-hooks cable. Sheaves must rotate freely on their headless pins and must afford smooth contact surfaces for the cable. Replace any parts which cannot be cleaned up properly by filing them smooth.

c. INSTALLATION.

- (1) Start one headless pin (fig. 53) through the pin bore in the top of the carrying-hooks-sheave lower bracket, and assemble over the pin inside the bracket a plain washer, one cable sheave, a second plain washer, a second cable sheave, and a third plain washer.

Note. The two sheaves used at this position are the two larger of the five sheaves used for the carrying-hooks cable.

Push the pin completely through the bracket and secure it with a new cotter pin.

- (2) From inside the lower bracket, insert the cable-drum-carrying-hooks pin (fig. 53) up into the small enclosure welded to the side of the bracket, installing the helical spring over the top end of the pin (inside the enclosure), and securing the spring on the pin with a nut and a new cotter pin.

Note. The spring will have the proper tension when the nut is far enough on the pin to insert the cotter pin.

- (3) Start a headless pin (fig. 53) through the lower pin bore in the carrying-hooks-lower-sheave bracket, and install over the end of this pin inside the bracket a plain washer, the carrying-hooks-cable drum, and a second plain washer.

Note. In order to install the cable drum it will be necessary to pull the cable-drum-carrying-hooks pin outward against the tension of its spring until the side of the drum is engaged under the head of the pin.

Push the headless pin on through the bracket and secure it with a new cotter pin.

- (4) Start a headless pin through the pin hole in the carrying-hooks upper-sheave bracket, and install over the end of

this pin inside the bracket the carrying-hooks-upper-bracket-sheave spacer, a cable sheave, and a plain washer.

Note. The spacer is at the right and the plain washer at the left of the cable sheave when properly installed.

Push the headless pin on through the bracket and secure it with a new cotter pin.

- (5) Start the remaining headless pin through the carrying-hooks-cable-guide-sheave support, and install over the end of the pin inside the support a plain washer, a cable sheave, a second plain washer, a second cable sheave, and a third plain washer. Push the pin on through the support and secure it with a new cotter pin.
- (6) Install the carrying-hooks cable (par. 76).

Section XI. CARRYING-HOOKS SHAFT

78. Removal

a. Disconnect the two ends of the carrying-hooks cable (fig. 36) by removing the nut and pin from the cable-end assembly at the top end of the cable turnbuckle.

b. Remove the screw, lock washer, and cable-drum block from the carrying-hooks-cable-drum body at the left end of the carrying-hooks shaft, and unwind the cable from the drum body.

c. Remove two nuts, lock washers, and screws and remove the carrying-hooks-cable-drum-body plate from the left end of the shaft (figs. 34, 36, and 53).

d. Loosen the setscrew in each of the two carrying hooks, so that the hooks are free on the shaft (fig. 34).

e. Pull the shaft toward the left, out of the carrying-hooks brackets, removing each of the two hooks as they are freed.

f. Slide the carrying-hooks-cable-drum body off of the shaft at the right end.

79. Installation

a. Install the carrying-hooks-cable-drum body (figs. 34 and 53) over the right end of the carrying-hooks shaft. Push the drum body all of the way to the left end of the shaft, engaging it over the square section at this end.

b. Install the shaft, right end first, through the four carrying-hooks brackets (fig. 34) at the front of the vehicle, engaging each of the two carrying hooks over the shaft as the shaft is passed through each pair of brackets.

c. Position the shaft so that the detents in the shaft are alined with

the ends of the setscrews in the respective carrying hooks. Tighten both setscrews so that the two hooks are firmly secured to the shaft.

d. Position the shaft so that the two carrying hooks are up with their back surfaces touching the vehicle hull. Position the cable-drum body on the square end of the shaft so that the threaded bore in the drum body is at the top. Attach the cable-drum-body plate to the drum body with two screws, lock washers, and nuts.

e. Wrap the turnbuckle end of the carrying-hooks cable (fig. 36) one and one-half turns around the cable-drum body to place the turnbuckle end of the cable closest to the vehicle hull. Connect the two ends of the cable together by engaging the cable-end assembly with the turnbuckle and securing it in place with a nut and pin.

f. Position the carrying-hooks operating lever (fig. 35) with the knob end as far forward as it will go toward the "CARRYING HOOKS UP" decalcomania, then rotate the carrying-hooks shaft, without changing the cable position, to place the carrying hooks up with their back surfaces touching the vehicle hull. Now install the carrying-hooks-cable-drum block to the cable-drum body (fig. 36) by installing the lock washer and screw which hold this block. Insert the screw into the drum body between two loops of the cable, and tighten the screw securely.

Section XII. EMERGENCY-LIFT HYDRAULIC JACK, CABLE, CABLE SHEAVES, AND CABLE-GUIDE SEAL AND RETAINER

80. Emergency-Lift Hydraulic Jack

a. REMOVAL.

- (1) Remove the screw, lock washer, and pin which secure the emergency-lift cable (anchor-end) connector to the hydraulic-jack mounting bracket (fig. 54), and disconnect the cable from the bracket.
- (2) Remove two screws and washers and remove the emergency-lift-cable clip from the sheave support at the end of the jack-piston ram. Pull the freed end of the cable out of the way.
- (3) Remove two screws and lock washers and remove the hydraulic-jack mounting clamp (fig. 54) from the mounting blocks welded to the inside of the vehicle hull—thus allowing the jack to swing down and hang from its mounting bracket.
- (4) Disconnect the hand-operated-pump-to-hydraulic-jack rubber hose from the jack by disconnecting it at the elbow near the top of the jack (Y, fig. 52).
- (5) Remove the screw, lock washer, and pin (fig. 54) which

secure the jack to the mounting bracket, and remove the jack from the bracket.

b. **MAINTENANCE.** The jack-piston ram should be free of scratches, burrs, and rust spots, the presence of which would tend to cause oil leakage. Light scratches and/or rust spots can be rubbed smooth by using a fine grade of abrasive cloth. Use the cloth dry, and rub very lightly over the spot to be removed, being careful not to scratch the metal by rubbing too hard or too continuously at one spot. If the scratch or rust spot is too deep to be removed in this manner, install a new jack and refer the damaged jack to ordnance maintenance personnel.

c. **INSTALLATION.**

- (1) Lift the jack up to the mounting bracket (fig. 54) and aline the pin bore at the top of the jack with the pin bores in the bottom edge of the bracket at back. Insert the pin to hold the jack in place and secure the pin with a lock washer and screw.

Note. The jack is properly installed when the hydraulic-line fittings near the top of the jack are at the left side.

- (2) Swing the jack upward against the hydraulic-jack mounting blocks and secure it in place by installing the hydraulic-jack mounting clamp with two screws and lock washers.
- (3) Turn the end of the emergency-lift cable 180° around the sheave at the end of the jack-piston ram, and pass the cable end up the front of the jack to aline the pin bore in the cable (anchor-end) connector with the pin bores at the lower front corner of the jack mounting bracket. Attach the connector to the bracket with the pin (fig. 54), and secure the pin with a lock washer and screw.

Note. If the cable has not been tampered with, it should still be in adjustment so that the cable connector can be attached to the bracket without readjustment of the cable length. However, if readjustment is necessary, proceed as instructed in paragraph 81 c, (11) to (14).

- (4) Install the emergency-lift-cable clip around the cable and over the sheave support at the end of the jack-piston ram, and secure it in place with two screws and lock washers (fig. 54).

81. Emergency-Lift Cable

a. **REMOVAL.**

- (1) Disconnect the outer end of the emergency-lift cable from the boss that projects backward at the left-front corner of

the right push beam (fig. 49) by removing the nut and clevis pin from the cable clevis (fig. 54) at this end of the cable.

- (2) Remove two screws and lock washers and remove the emergency-lift-cable guard from the top of the right-inner tilt arm (fig. 34).
- (3) Pull the free end of the emergency-lift cable up through the opening in the right-inner tilt arm.
- (4) Remove the cable clevis by screwing the clevis part off of the clevis sleeve, prying out the clevis plug, and pulling the sleeve off of the cable end.
- (5) From on top of the vehicle, pull the free end of the cable back through the emergency-lift-cable-outer-sheave support (fig. 38).
- (6) Remove three screws and lock washers and remove the emergency-lift-cable-guide-weather-seal retainer (fig. 38). Slip the weather seal off of the free end of the cable.
- (7) From inside of the vehicle, pull the free end of the cable down through the emergency-lift-cable guide (fig. 38) and out the bottom of the hydraulic-jack-mounting bracket (fig. 54).
- (8) Remove the screw, lock washer, and the pin which attaches the emergency-lift-cable (anchor-end) connector to the hydraulic-jack-mounting bracket—and slip the connector out of the bracket.
- (9) Remove two screws and washers and the emergency-lift-cable clip from the lower end of the jack-piston ram, and pull the cable free from the jack.

b. MAINTENANCE. Inspect the ends of the cable removed from the cable clevis to make certain that the strand ends are not bent or damaged so that the cable will be weakened when it is reinstalled in the clevis. Inasmuch as there is relatively little adjustment provided for in the cable (allowable adjustment is limited by the length of the threaded portion of the sleeve part of the (anchor-end) connector (fig. 54)), damaged cable ends cannot be cut back more than 2 or 3 inches to provide an undamaged end for installation of the clevis. If there is need to cut the cable back farther than this, or the cable has already been cut back as far as permissible, or if it is damaged at other portions, a new cable must be installed.

c. INSTALLATION.

- (1) Thread the plain end of the cable upward through the hydraulic-jack-mounting bracket (inside of the vehicle) at the rear of the sheave in this bracket, and push the end on up and through the opening in the emergency-lift-cable guide on the outside top of the vehicle hull (fig. 54).

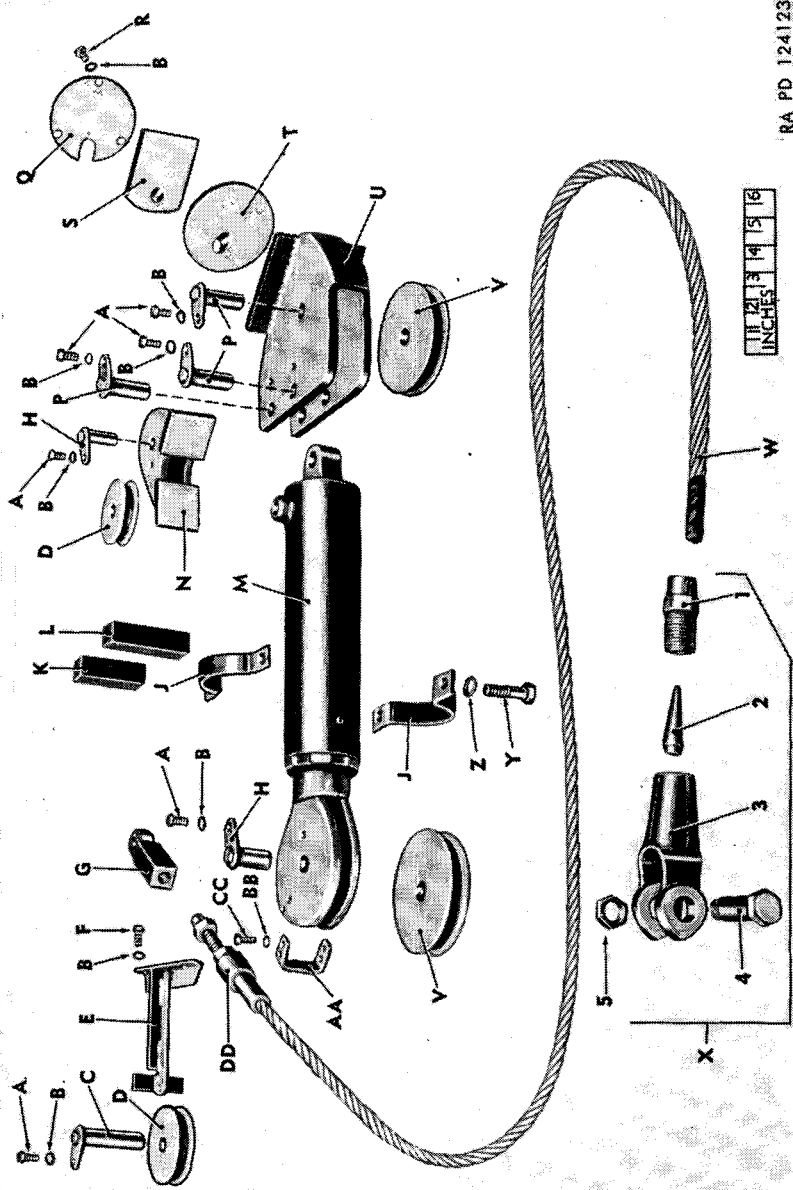


Figure 54. Emergency-lift hydraulic jack, cable, cable sheaves, and sheave supports—exploded view.

A— $\frac{3}{8}$ -24NF-3 x $\frac{3}{4}$ SCREW
 B— $\frac{3}{8}$ -IN LOCK WASHER
 C— $4\frac{1}{4}$ x 0.995-IN PIN
 D—TILT-ARM-AND-OUTER-SHEAVE-SUPPORT CABLE SHEAVE
 E—CABLE GUARD
 F— $\frac{5}{8}$ -18NF-2 x $2\frac{1}{2}$ SCREW
 G—CABLE (ANCHOR-END) CONNECTOR
 H— $2\frac{5}{8}$ x 0.995-IN PIN
 J—MOUNTING CLAMP
 K— $4\frac{3}{4}$ -IN HYDRAULIC-JACK MOUNTING BLOCK
 L—4-IN HYDRAULIC-JACK MOUNTING BLOCK
 M—EMERGENCY-LIFT HYDRAULIC JACK
 N—OUTER-SHEAVE SUPPORT
 P— $3\frac{1}{16}$ x 0.995-IN PIN
 Q—WEATHER-SEAL RETAINER
 R— $\frac{3}{8}$ -24NF-2 x $\frac{3}{4}$ SCREW
 S—CABLE-GUIDE WEATHER-SEAL
 T—CABLE GUIDE
 U—HYDRAULIC-JACK MOUNTING BRACKET
 V—JACK-RAM-AND-JACK-MOUNTING-BRACKET SHEAVE
 W—EMERGENCY-LIFT CABLE
 X—CABLE-CLEVIS ASSEMBLY
 1—SLEEVE
 2—PLUG
 3—CLEVIS
 4—CABLE-CLEVIS PIN
 5— $\frac{7}{8}$ -14NF-2 JAM NUT
 Y— $\frac{5}{8}$ -18NF-3 x 2 SCREW
 Z— $\frac{5}{8}$ -IN LOCK WASHER
 AA—CABLE CLIP
 BB— $\frac{1}{4}$ -IN LOCK WASHER
 CC— $\frac{1}{4}$ -28NF-2 x $\frac{3}{4}$ SCREW
 DD—CABLE END

Figure 54 —Continued

- (2) Thread the cable end (just passed out of the vehicle) through the hole of a new cable weather seal, then pass it through the groove of the sheave in the emergency-lift-cable-outer-sheave support (fig. 38). The cable should pass between the sheave and the cross bar welded to the top of this support.
- (3) Pull the exterior end of the cable down along the vehicle hull until there is approximately 4 feet of cable length left inside the vehicle.
- (4) Wrap the plain end of the cable (now outside the vehicle) with wire for a distance of one-half inch, at each of three places approximately one-half inch, 3 inches, and 6 inches from the end.

Note. If the cable end has not been cut off, the second and third wire wraps will already be there.

- (5) Push the cable-clevis sleeve (fig. 54), plain end first, over the cable end far enough to prevent the cable from fanning out,

- then remove the first wire wrap. Insert a screwdriver into the center of the cable strands to spread them out, pry out the hemp center, then cut the hemp center off just below the center wire wrap if hemp center has not already been cut off.
- (6) Push the cable-clevis sleeve over the cable far enough to insert the cable-clevis plug among the cable strands so that each strand lies in a groove of the plug (fig. 54). Alternately tap the sleeve and plug to drive them onto the cable, until the lower end of the sleeve is approximately $3\frac{5}{16}$ inches from the end of the cable. Drive the plug in so that it seats solidly.
 - (7) Compress the protruding cable strands and screw the clevis tightly onto the clevis sleeve.
 - (8) Pass the clevis end of the cable down through the opening in the right-inner tilt arm (to the right of the carrying-hooks-engagement-pin assembly on the top of this tilt arm) (fig. 34) and pull it out through the bottom of the tilt arm. Install the emergency-lift-cable guard and secure it with two screws and lock washers.
 - (9) Connect the cable clevis to the boss that projects backward from the left-front corner of the right push beam (fig. 49), securing the clevis to the boss with the clevis pin and nut (fig. 54).
 - (10) From inside of the vehicle, pull the cable taut, pass it down along the rear of the hydraulic jack, turn it 180° around the sheave at the end of the jack-piston ram, and pass the end upward along the front of the jack to place the connector at this end against the hydraulic-jack mounting bracket.
 - (11) Start the vehicle engine (TM 9-718), and lower the moldboard to its extreme lowered position (par. 44), then place the control-valve-control-operating lever at "HOLD."
 - (12) With the moldboard all the way down and the cable pulled taut, adjust the cable (anchor-end) connector so that the eye at the end of the connector will be aligned with the pin bore at the lower-front corner of the hydraulic-pack mounting bracket.

Note. To adjust the connector (G, fig. 54) loosen the large nut, turn the end of the connector (counterclockwise to lengthen cable or clockwise to shorten cable) and tighten the nut against the connector end.

- (13) Attach the connector to the hydraulic-jack mounting bracket with a pin, lock washer, and screw (fig. 54).
- (14) Install the emergency-lift-cable clip around the cable and the sheave support at the end of the jack-piston ram, and secure it with two screws and lock washers.

- (15) Press the cable-guide weather seal (fig. 38) down flat on top of the cable guide, and install the weather-seal retainer with three lock washers and screws.

82. Cable Sheaves and Cable-Guide Seal and Retainer

a. REMOVAL.

- (1) Remove the screw, lock washer, and pin (fig. 54), and remove the cable sheave from the bracket (fig. 39) on the under side of the right-inner tilt arm.
- (2) Remove the screw, lock washer, and pin, and remove the cable sheave (fig. 54) from the emergency-lift-cable-sheave support (fig. 38) at the top front of the vehicle hull.
- (3) Remove the screw, lock washer, and pin, and remove the cable sheave (fig. 54) from the hydraulic-jack mounting bracket inside of the vehicle.
- (4) Remove two screws and washers and remove the emergency-lift cable clip from around the sheave support at the end of the jack-piston ram. Remove the screw, lock washer, and pin, and remove the cable sheave from the support.
- (5) Remove three screws and lock washers and remove the emergency-lift-cable-guide-weather-seal retainer (fig. 38).

Note. In order to remove the emergency-lift-cable weather seal, it is necessary to follow the procedure for removal of the cable (par. 81) up to the point at which the seal is removed from around the cable.

b. MAINTENANCE. Inspect the pins for deep scratches and worn spots which would interfere with rotation of the sheaves which they support. Inspect the flanges of the sheaves for rough or worn spots which would damage the emergency-lift cable. Sheaves must rotate freely on their pins and must afford smooth contact surfaces for the cable. Replace any parts which cannot be cleaned up properly by filing them smooth, or by using a fine grade of abrasive cloth.

c. INSTALLATION.

Note. If the cable-guide weather seal (fig. 38) has been removed, it will be necessary to install a new weather seal over the cable during installation of the cable (par. 81).

- (1) Press the weather seal (fig. 38) down flat on top of the emergency-lift-cable guide, and install the weather-seal retainer with three screws and lock washers.
- (2) Pull the cable to one side and insert the cable sheave into the hydraulic-jack mounting bracket above the jack mounting position (fig. 54). Secure the sheave in place by installing the pin, screw and lock washer.
- (3) Pull the cable to one side and install the cable sheave in

the support at the end of the jack-piston ram by installing the pin that holds the sheave and secure the pin with a screw and lock washer (fig. 54). Loop the cable around the sheave, and install the emergency-lift-cable clip, securing it in place with two screws and lock washers.

- (4) Push the cable sheave into place in the emergency-lift-cable-outer-sheave support (fig. 38) by inserting it backward through the front end of the support under the cable. Install the pin that holds the sheave and secure the pin with a screw and lock washer.
- (5) Install a cable sheave (fig. 54) in the sheave support that is welded to the under side of the right-inner tilt arm, insert the pin that holds the sheave, and secure the pin in place with a screw and lock washer. Lift the cable into place on the groove of the sheave.

Section XIII. EMERGENCY-LIFT HAND-OPERATED PUMP AND RESERVOIR

83. Removal

a. Disconnect the pump-to-jack rubber hose (BB, fig. 52) from the adapter on the jack, then remove the hose from the pump.

b. Remove four screws which attach the pump to the reservoir (fig. 46) and remove pump from reservoir.

c. Remove four screws and lock washers which attach the reservoir to the mounting plate welded to vehicle floor, and remove reservoir.

Caution: The reservoir need not be drained prior to removal, but do not tilt it or oil will spill out.

84. Installation

a. Position the reservoir on the mounting plate (welded to the vehicle floor at the assistant-driver's left hand) (fig. 37) with the side that holds the oil-filler plug at the left (fig. 46). Secure it in place with four cap screws (fig. 71).

b. Position the pump on the reservoir with the release-valve lever at the right (fig. 46). Secure it in place with four screws and lock washers.

c. Attach one end of the pump-to-jack rubber hose (BB, fig. 52) to the outlet at the front side of the pump housing, and connect the other end of the hose to the adapter on the hydraulic jack (fig. 54).

Section XIV. CONTROL-VALVE CONTROL AND LINKAGE

85. Control-Valve Control

a. REMOVAL.

- (1) Remove the screw and lock washer (fig. 56) which hold the rod-end ball bearing of the control-linkage front rod to the control-valve-linkage yoke (fig. 55) on the control-valve control. Push the bearing down and out of the yoke.
- (2) Remove two screws, nuts, and lock washers and lift the control from its mounting bracket.

Note. These two screws, nuts, and lock washers bolt the control-operating-lever support to the mounting bracket, and there is a lever-support spacer installed between the support and the bracket. This spacer will also be freed by removal of the assembly.

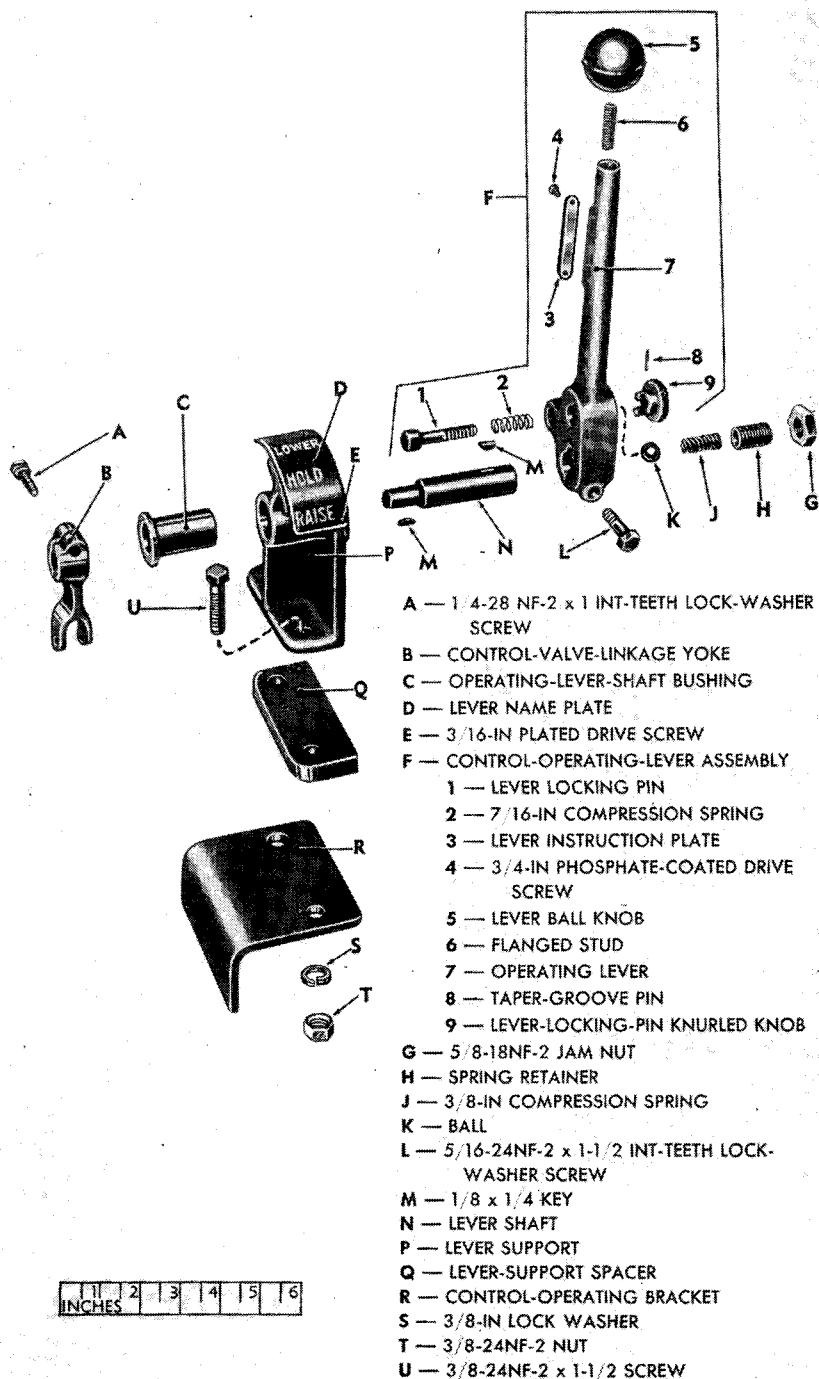
b. INSTALLATION.

- (1) Place the control-operating-lever-support spacer (fig. 55) on top of the valve-operating-control mounting bracket (welded to the inside of the vehicle hull at the driver's left hand, fig. 33), and aline the bolt holes in the spacer with the bolt holes in the bracket, with the square-cornered edge of the spacer at the right.
- (2) Place the control-valve control on top of the spacer, with the lever at right and the bolt holes in the lever support alined with the bolt holes in the spacer and mounting bracket.
- (3) Install two screws, lock washers, and nuts to bolt the lever support to the mounting bracket.

Note. If the adjustment was satisfactory prior to removal of the control, and the linkages have not been tampered with in the meantime, no adjustment of the linkages will now be necessary and step (4) will complete installation of the control assembly. If adjustment is required, however, omit (4) and perform steps (5) through (8).

- (4) Insert the rod-end ball bearing (fig. 56), at the front end of the control-linkage front rod, into the control-valve-linkage yoke (fig. 55) installed on the control. Secure the bearing in place with a screw and lock washer.
- (5) Position the rear-rod-to-valve-stem-head link (fig. 56), on the control valve, in its extreme rear position, and move the control-valve-control operating lever to "FLOAT" position.
- (6) Loosen the jam nut at each end of the control-linkage front rod. Lengthen or shorten the rod by adjusting the rod-end ball bearings at the two ends of the rod until the front bearing will exactly fit into place in the control-valve-linkage yoke (fig. 55) already installed on the control.

Note. If the threaded ends of the rod are not long enough to make a satisfactory adjustment, make a similar adjustment of the control-



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Figure 55. Control-valve control—exploded view.

valve-control-linkage rear rod (fig. 56). Both rods together will afford ample adjustment.

- (7) Install the front bearing of the front rod in the yoke on the control, and secure it in place with the screw and lock washer.
- (8) Tighten the jam nuts that have been loosened in (6) above.

86. Control-Valve-Control Operating Lever

a. REMOVAL.

- (1) Loosen the screw by which the clamping base of the operating lever is secured to the lever shaft (fig. 55). Remove the key from the end of the shaft, and slide the lever off of the shaft.

Note. If it is also necessary to remove the operating-lever-shaft bushing and shaft, proceed as follows:

- (2) Remove the lever support (par. 85).
- (3) Pull the linkage yoke, with the lever shaft attached, out from the left side of the lever support (fig. 55). Remove the screw and lock washer from the clamping portion of the yoke, and remove the yoke and key from the shaft.
- (4) Tap the lever-shaft bushing out of the support (fig. 55), removing it at the left side of the support and tapping it out with a piece of wood turned down to the diameter of the bushing bore in the support.

b. INSTALLATION.

- (1) Insert the operating-lever-shaft bushing (fig. 55) into the bore of the lever support from the left side, and push it in until the collar of the bushing is seated against the side of the support.
- (2) Insert the key in the slot in the small end of the lever shaft, and install the linkage yoke on the shaft. Secure the yoke with a lock washer and screw.
- (3) Install the lever shaft in the bushing, pushing it through the bushing until the yoke at the end of the shaft is up against the flange at the left side of the bushing.
- (4) Install the lever support (par. 85).
- (5) Install the operating lever on the right end of the shaft, locking it with a key fitted into the slot at the end of the shaft, and securing it by tightening the screw in the clamping jaw at the base of the lever.

87. Control-Operating-Lever Locking Pin

a. REMOVAL.

- (1) Remove the jam nut at the base of the operating lever (fig. 55).
- (2) Remove the spring retainer, spring, and ball from the recess in the lever base that was closed by the jam nut.
- (3) Remove the operating lever from the lever support (par. 86a).
- (4) Remove the taper-groove pin from the lever-locking-pin knurled knob, pull the knob off of the lever-locking pin, and remove the pin and spring from the pin bore in the base of the lever.

b. **MAINTENANCE.** The two springs must not be bent or broken, and must be free to compress or expand freely. If the springs are dirty, wash them thoroughly, and also clean out the bores in the base of the operating lever in which the springs are housed, using dry-cleaning solvent or volatile mineral spirits paint thinner. If the ball is worn flat at one side, or damaged, install a new ball. If the head of the locking pin is worn or damaged, install a new locking pin.

c. INSTALLATION.

- (1) Place the $\frac{7}{16}$ -inch spring (fig. 55) over the shaft of the lever-locking pin, and install the spring and pin in the pin bore at the base of the operating lever.
- (2) Push the pin through the bore (compressing the spring as necessary), and install the lever-locking-pin knurled knob at the right end of the pin, securing the knob to the pin with a new taper-groove pin.
- (3) Install the operating lever on the lever support (par. 86b).
- (4) Install the ball, $\frac{3}{8}$ -inch spring, and spring retainer in the remaining bore at the base of the lever. Push the retainer in to compress the spring as necessary, and install the jam nut to hold these parts in place.
- (5) Tighten the jam nut so that the operating lever will move freely between any two of the four lever positions indicated by the instruction plate on the support, and so that it will require considerable force to move the lever from any one of the four indicated positions.

Note. Turning the jam nut clockwise will increase the force required to move the lever; turning the nut counterclockwise will decrease the required force.

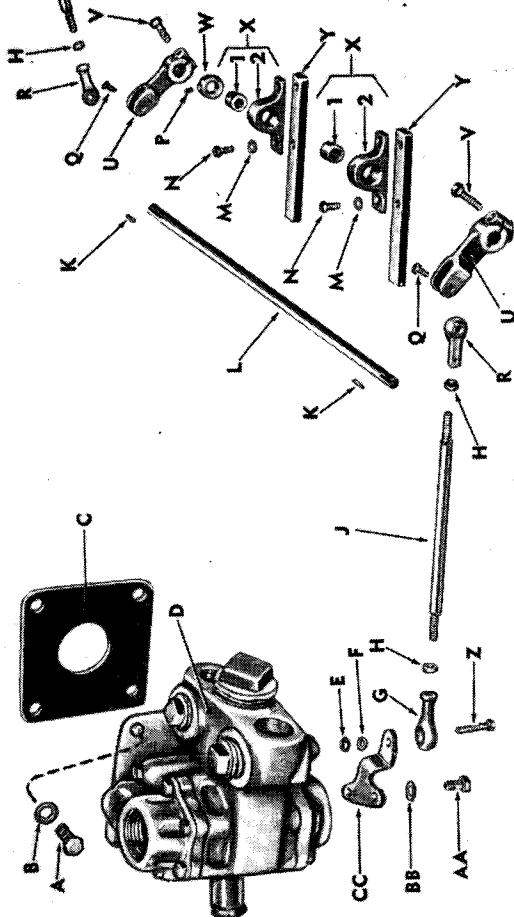
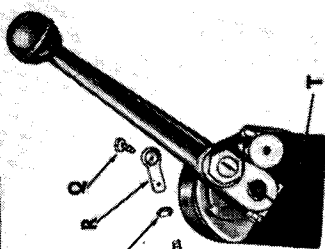
88. Control-Valve Control Linkage

a. REMOVAL (fig. 56).

- (1) Remove the screw and lock washer (fig. 56) and disconnect

- A — 1/2-20NF-3 x 1-1/4 SCREW
 B — 1/2-IN LOCK WASHER
 C — CONTROL-VALVE-TO-HYDRAULIC-PUMP-RESERVOIR
 GASKET
 D — HYDRAULIC-PUMP CONTROL VALVE ASSEMBLY
 E — 1/4-28NF-2 NUT
 F — 3/8-IN LOCK WASHER
 G — 0.25-IN ROD-END BALL BEARING
 H — 5/16-24NF-2 JAM NUT

- J — REAR ROD
 K — KEY
 L — CONTROL-VALVE CONTROL SHAFT
 M — 1/4-IN LOCK WASHER
 N — 1/4-28NF-2 x 5/8 SCREW
 P — 3 x 1/4-IN SET SCREW
 Q — NO 10 (0.190) — 32NF-2 X 7/8 SCREW
 R — 0.19-IN ROD-END BALL BEARING
 S — FRONT ROD



- T — CONTROL-VALVE CONTROL
 U — YOKE
 V — 1/4-28NF-2 x 1 SCREW
 W — SHAFT COLLAR
 X — SHAFT SUPPORT ASSEMBLY
 1 — BUSHING
 2 — SHAFT SUPPORT
 Y — SUPPORT MOUNTING PAD
 Z — 1/4-28NF-2 x 1-1/4 SCREW
 AA — 3/8-16NC-2 x 5/8 SCREW
 BB — 3/8-IN LOCK WASHER
 CC — REAR-ROD-TO-VALVE-STEM-HEAD-LINK

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Figure 56. Control-valve-control linkage—Exploded view.

the front rod from the control-valve-linkage yoke (fig. 55) installed on the operating-lever shaft.

- (2) Remove the screw and lock washer and disconnect the front rod from the yoke at the left end of the control-valve control shaft.

Note. The two rod-end ball bearings can be removed from the front rod by loosening the jam nuts at each end of the rod, then screwing off the bearings and the jam nuts.

- (3) Remove the screw, nut, and lock washer and disconnect the rear end of the rear rod from the rear-rod-to-valve-stem-head link.
- (4) Remove two screws and lock washers, and remove the link from the control-valve-stem head.
- (5) Remove the screw and lock washers, and disconnect the yoke at the right end of the control-valve control shaft.

Note. The two rod-end ball bearings at the ends of the rear rod can be removed by loosening the jam nuts at the ends of the rod and by screwing the bearings and jam nuts off of the rod.

- (6) Loosen the screw in the base of the yoke at the right end of the control-valve-control shaft, and remove the yoke and key from this end of the shaft.
- (7) In like manner, remove the yoke from the left end of the shaft.
- (8) Loosen the set screw in the shaft collar, and pull the shaft to the right out of the two shaft supports, thus also freeing the collar.
- (9) Remove two screws and lock washers, and remove one of the two shaft supports from its mounting pad.
- (10) In like manner, remove the other shaft support.
- (11) Tap the two bushings out of the two shaft supports, using a piece of wood turned down to fit the bores in the shaft supports.

b. MAINTENANCE. The two rods and the shaft must not be bent, and the shaft must have round, polished bearing surfaces at the two points at which it is supported by the bushings in the shaft supports. The two bushings must have round, polished bores. If the rods or shafts are bent, and cannot be satisfactorily straightened, install new rods and/or shafts. If the bearing surfaces of the shaft are badly worn, out of round, or scratched, install a new shaft. If the bushings are badly bent or scratched, install new bushings. If any of the screws which serve as bearing pins for the rod-end ball bearings are damaged, or if any of the rod-end bearings are worn so that the bores for the screws are out of round or a sloppy fit over the screws, install new screws and/or bearings. If the rear-rod-to-valve-stem-head link

is bent, or if the screw bore at the front of the link (which serves as a bearing point for the screw that secures the rear rod to the link) is worn, install a new link.

c. INSTALLATION.

- (1) Install the two bushings (fig. 56) in the respective shaft supports, seating each bushing all the way in the bore of the support.
- (2) Install the two supports on their mounting pads, securing each with two screws and lock washers.
- (3) Install the valve-control shaft in the two shaft supports, inserting it from the right side and pushing it to the left through the support bushings. Place the shaft collar over the left end of the shaft, but do not tighten the set screw of the collar.
- (4) Install the two yokes at the respective ends of the control shaft, locating each with respect to the shaft by installing a key in the slot of the shaft, and binding each yoke to the shaft by tightening the screw at the base of the yoke.
- (5) Install the two jam nuts at the respective ends of the rear rod, running each nut approximately half way up onto the threaded portion of the rod. Install the two rod-end ball bearings, tightening these up against the jam nuts and, at the same time, position the two bearings so that the center lines of the bores in the bearings are parallel.
- (6) Attach the rod-end bearing at one end of the rear rod to the yoke at the left end of the control-valve-control shaft, using a screw and lock washer.
- (7) Position the rear-rod-to-valve-stem-head link on the control-valve-stem head so that the projecting member of the link points toward the front of the vehicle, and secure the link to the valve-stem head with two screws and lock washers.
- (8) Attach the rod-end ball bearing at the rear end of the rear rod to the above link with a screw, lock washer, and nut.
- (9) Install the two jam nuts at the respective ends of the front rod, running each nut approximately half way up on the threaded end of the rod. Install the two rod-end ball bearings, but tighten the bearing at one (rear) end of the rod only, by turning it up tight against the jam nut.
- (10) Connect one end of the front rod to the yoke at the right end of the control-valve-control shaft by installing the tightened bearing in the yoke and securing it with a screw and lock washer.
- (11) Rotate the rear-rod-to-valve-stem-head link to its extreme

rear position, and move the control-valve-control operating lever to "FLOAT" position.

- (12) Position the bearing at the front of the front rod so that it will slip into the yoke installed on the operating-lever shaft, without movement of the linkage or the operating lever.

Note. If there is not enough thread at the front end of the front rod to adjust the bearing, it will be necessary to loosen the jam nut at the rear end of the rod, and make additional adjustment of the rod by turning the rod into or out of the bearing at the rear end. If this additional adjustment is still insufficient, it will be necessary to loosen one or both of the jam nuts on the rear rod in order to make an additional adjustment (lengthening or shortening) of the rear rod.

- (13) When the rods have been properly adjusted, tighten the jam nuts to secure the adjustment.
- (14) Connect the front rod to the yoke on the operating-lever shaft by installing the screw and lock washer which hold the bearing at this end of the rod to the yoke.

Section XV. HYDRAULIC-PUMP CONTROL VALVE AND INTERIOR HYDRAULIC LINES

89. Control Valve

a. **REMOVAL.**

- (1) Remove screw, nut, and lock washer and disconnect the rod-end ball bearing (fig. 56) at the rear end of the control-valve-control-linkage rear rod from the rear control-rod-to-valve-stem-head link on the control valve.
- (2) Disconnect the hydraulic-cylinder-to-control-valve lower-rear line (fig. 52) from the compression elbow installed in the front of the control valve.
- (3) Disconnect the hydraulic-cylinder-to-control-valve-upper-rear line from the second elbow installed in the front of the control valve.
- (4) Disconnect the hydraulic-pump-to-control-valve hose from the right-angle-male-adaptor union installed in the top of the control valve.
- (5) Remove four screws and lock washers and remove the control valve (fig. 56) and the gasket from the hydraulic-pump oil reservoir (fig. 58).

b. **MAINTENANCE.**

- (1) The gasket must not be torn or broken, and the mounting surface of the valve and the mounting block on the reservoir must be clean and level so that there will be no oil leakage around the gasket. Clean both mounting surfaces thor-

oughly with dry-cleaning solvent or volatile mineral spirits paint thinner, and install a new gasket, if necessary.

- (2) Remove the check-valve cap (fig. 60) and take the check-valve-pusher spring, inner check valve, outer check valve, and check-valve pusher out of the bore in the valve body. Clean these parts thoroughly with dry-cleaning solvent or volatile mineral spirits paint thinner, and especially clean out the small bore in the side of the inner check valve. Insert the pusher (large end first), outer check valve (small end first), inner check valve (stem end first), and spring into the valve-body bore. Install and tighten the cap. If spring is bent or broken, use a new spring. If other parts are damaged, refer to ordnance-maintenance personnel.
- (3) Remove the cam-stop-head cap (fig. 60), relief-valve adjusting screw, relief-valve spring, and relief valve. Clean these parts thoroughly with dry-cleaning solvent or volatile mineral spirits paint thinner. Install the relief valve (short stem end first), spring, and adjusting screw. Screw must be adjusted after installation (*c* below), and cap will be installed after adjustment is made. If spring is bent or broken, use a new spring. If other parts are damaged, refer to ordnance maintenance personnel.

c. INSTALLATION.

- (1) Position the gasket (fig. 56) on the pump-reservoir mounting pad (fig. 58). Position the control valve (fig. 56) on the gasket, placing the two outlet ports of the valve at the front. Secure the valve with four screws and lock washers.
- (2) Connect the hydraulic-cylinder-to-control-valve lower-rear line (fig. 52) to the lower one of the two elbows installed in the front of the control valve.
- (3) Connect the hydraulic-cylinder-to-control-valve upper-rear line to the remaining elbow installed in the front of the control valve.
- (4) Connect the hydraulic-cylinder-to-control-valve hose to the right-angle-male-adaptor union installed in the top of the control valve.
- (5) Attach the rod-end ball bearing (fig. 56) at the rear end of the control-valve-control-linkage rear rod to the front end of the rear-control-rod-to-valve-stem-head link on the control valve with a screw, nut, and lock washer.

Note. If the control linkage was in proper adjustment prior to the removal of the control valve, and has not been tampered with, no adjustment will be necessary. If, however, adjustment is required, proceed as outlined in paragraph 85.

- (6) Start the vehicle engine (TM 9-718) and raise and lower the moldboard (par. 44). Adjust the relief valve to stay closed while moldboard is in motion, but to open 2 to 3 seconds after moldboard reaches either extreme of travel. If valve opens too soon, moldboard will operate "jerkily" or not at all; if valve stays closed too long, hydraulic pump will be overloaded, gears and pump will "whine." To make valve open later, rotate the relief-valve-adjusting screw (fig. 60) clockwise; to make valve open sooner, rotate screw counterclockwise. Turn screw one-quarter turn at a time, checking moldboard operation at each screw position. If proper adjustment cannot be made, notify ordnance maintenance personnel.
- (7) Install the cam-stop-head cap and tighten it securely.

90. Interior Hydraulic Lines

a. REMOVAL.

- (1) Remove the screws and lock washers (fig. 52), and remove the clamp that secures the two laterally-disposed hydraulic lines to the front of the vehicle front bulkhead. In the same manner, remove the clamp that secures the lines to the right wall of the vehicle.
- (2) Disconnect the hydraulic-cylinder-to-control-valve upper rear line from the elbow installed in the control valve. Disconnect the other end of the line from the hydraulic-cylinder-to-control-valve upper front line (fig. 52).
- (3) In similar manner, remove the hydraulic-cylinder-to-control-valve lower rear line.
- (4) Remove the hydraulic-piping upper guard (par. 71).
- (5) Disconnect the hydraulic-cylinder-to-control-valve upper front line from the elbow at the front of the vehicle.
- (6) Disconnect the hydraulic-cylinder-to-control-valve lower front line from the elbow at the front of the vehicle.

b. MAINTENANCE. All lines must be free of obstructions or breaks which could cause stoppage of oil flow or leakage. When any line is crushed or broken, install a new line. Inspect the threads of each line for damage which would cause the linkage to be insecure when installed. Replace any line which has damaged threads.

c. INSTALLATION.

- (1) Connect the hydraulic-cylinder-to-control-valve lower front line (fig. 52) to the elbow at the front of the vehicle.

Note. The end having the short bend is the rear end. When installed, the short rear portion of the line should point straight to the left.

- (2) In like manner, connect the hydraulic-cylinder-to-control-valve upper front line to the elbow at the front of the vehicle.
- (3) Install the hydraulic-piping upper guard (par. 71).
- (4) Position the two lines just installed on the mounting block welded to the right wall of the vehicle, place the clamp around the lines, and secure the clamp to the mounting block with a screw and lock washer.
- (5) Connect the straight end of the hydraulic-cylinder-to-control-valve lower rear line to the rear end of the lower front line. Connect the other end of this rear line to the elbow at the lower front of the control valve.
- (6) In the same manner, connect the hydraulic-cylinder-to-control-valve upper rear line to the upper front line, and to the remaining elbow in the control valve.
- (7) Position the two lines just installed on the mounting block welded to the front of the vehicle front bulkhead, place the clamp around the two lines and secure the clamp to the block with a screw and lock washer.

Section XVI. HYDRAULIC PUMP, PUMP GEAR DRIVE, AND GEAR-DRIVE SUPPORT

91. Hydraulic Pump

a. REMOVAL.

- (1) Disconnect the control-valve-to-hydraulic-pump hose from the right-angle-male-adaptor union installed in the top of the hydraulic pump (fig. 32).
- (2) Disconnect the hydraulic-cylinder-to-control-valve upper-rear line from the elbow installed in the front of the control valve (fig. 52).
- (3) In the same manner, disconnect the hydraulic-cylinder-to-control-valve lower-rear line from the control valve.
- (4) Remove two screws and lock washers, and remove the left floor plate from above the hydraulic-pump oil reservoir (fig. 40).
- (5) Remove four screws and lock washers to detach the reservoir from its mounting plate (fig. 58).
- (6) Insert a cross bar between the front end of the reservoir and the rear of the vehicle front bulkhead to slide the reservoir backward on its mounting plate. While sliding the reservoir backward, disconnect the hydraulic-pump-to-reser-

voir hose from the adapter union installed in the reservoir (fig. 32).

Note. It will be necessary to slide the reservoir gradually in order to pull the union off the hose as the threads are loosened.

- (7) Remove six nuts and lock washers, and remove the hydraulic pump from the hydraulic-pump-gear-drive case.

b. INSTALLATION.

- (1) Position the mounting flange of the pump against the mounting surface at the front side of the hydraulic-pump-gear-drive case, inserting the male spline of the pump shaft into the female spline of the gear drive, and locating the flange over the studs in the gear-drive case so that the right-angle-male-adapter union (which connects the control-valve-to-hydraulic-pump hose to the pump), is directly at the top of the pump (fig. 32). Secure the pump in place with six nuts and lock washers.
- (2) Start the adapter union, which is installed near the bottom of the right side of the reservoir (fig. 32), over the end of the hydraulic-pump-to-reservoir hose. Use a crowbar between the back end of the oil reservoir and the bulkhead at the rear of the reservoir to move the reservoir forward on its mounting plate so that the adapter union can be turned completely onto the end of the hose.

Note. When the reservoir was pushed backward during removal to disconnect the union from this hose, the pads at the bottom edges of the reservoir dropped off the tops of the mounting blocks welded to the top of the mounting plate. While pushing the reservoir forward, it will be necessary to raise it sufficiently to relocate the pads on the tops of the mounting blocks.

- (3) Install four screws and lock washers to secure the reservoir to its mounting plate (fig. 58).
- (4) Connect the hydraulic-cylinder-to-control-valve lower-rear line (fig. 52) to the elbow in the lower-front side of the control valve.
- (5) Connect the hydraulic-cylinder-to-control-valve upper rear line to the remaining elbow in the front of the control valve.
- (6) Connect the control-valve-to-hydraulic-pump hose to the right-angle-male-adapter union installed in the top of the hydraulic pump (fig. 32).
- (7) Install the left floor plate over the oil reservoir, and secure it to its mounting blocks with two screws and lock washers (fig. 40).

92. Hydraulic-Pump Gear Drive

a. REMOVAL.

- (1) Remove the hydraulic pump (par. 91).
- (2) Remove the rear-ration-box cover (fig. 22).
- (3) Remove four screws and lock washers, and disconnect the hydraulic-pump-propeller-shaft journal (fig. 57), which is at the front end of the propeller shaft, from the hydraulic-pump-gear-drive splined flange (connected to the gear drive) (fig. 31).
- (4) Remove four nuts and lock washers, and remove the gear-drive case from the gear-drive support.

b. INSTALLATION.

- (1) Install the gear-drive case over the mounting studs of the gear-drive support with the left end of the case projecting through the opening cut in the bulkhead at the left side of the support (fig. 31). Secure the case to the support with four nuts and lock washers. Tighten the nuts securely.
- (2) Position the hydraulic-pump-propeller-shaft journal (fig. 57), which is at the front end of the propeller shaft, against the hydraulic-pump-gear-drive splined flange (installed at the left-rear of the gear-drive case) (fig. 31), and secure the two parts together with four screws and lock washers.
- (3) Install the rear-ration-box cover (fig. 22).
- (4) Install the hydraulic-pump (par. 91).

93. Hydraulic-Pump-Gear-Drive Support

a. REMOVAL.

- (1) Remove the hydraulic-pump gear drive (par. 92).
- (2) Remove the two screws, nuts, and lock washers which secure the support (fig. 31) to the vehicle-floor support under its front end, and remove the two screws and lock washers which secure the rear end of the support to the mounting-plate support under the rear end.

b. INSTALLATION.

- (1) Position the gear drive support with the rear end resting on the mounting-plate support (at the rear of the open area in which the hydraulic-pump reservoir is located) and with its front end resting on the vehicle-floor support which is at the approximate center of this area (fig. 31).
- (2) Secure the rear end of the support to the pump mounting-plate support with two screws and lock washers.
- (3) Secure the front of the support to the vehicle-floor support with two screws, lock washers, and nuts.
- (4) Install the hydraulic-pump gear drive (par. 92).

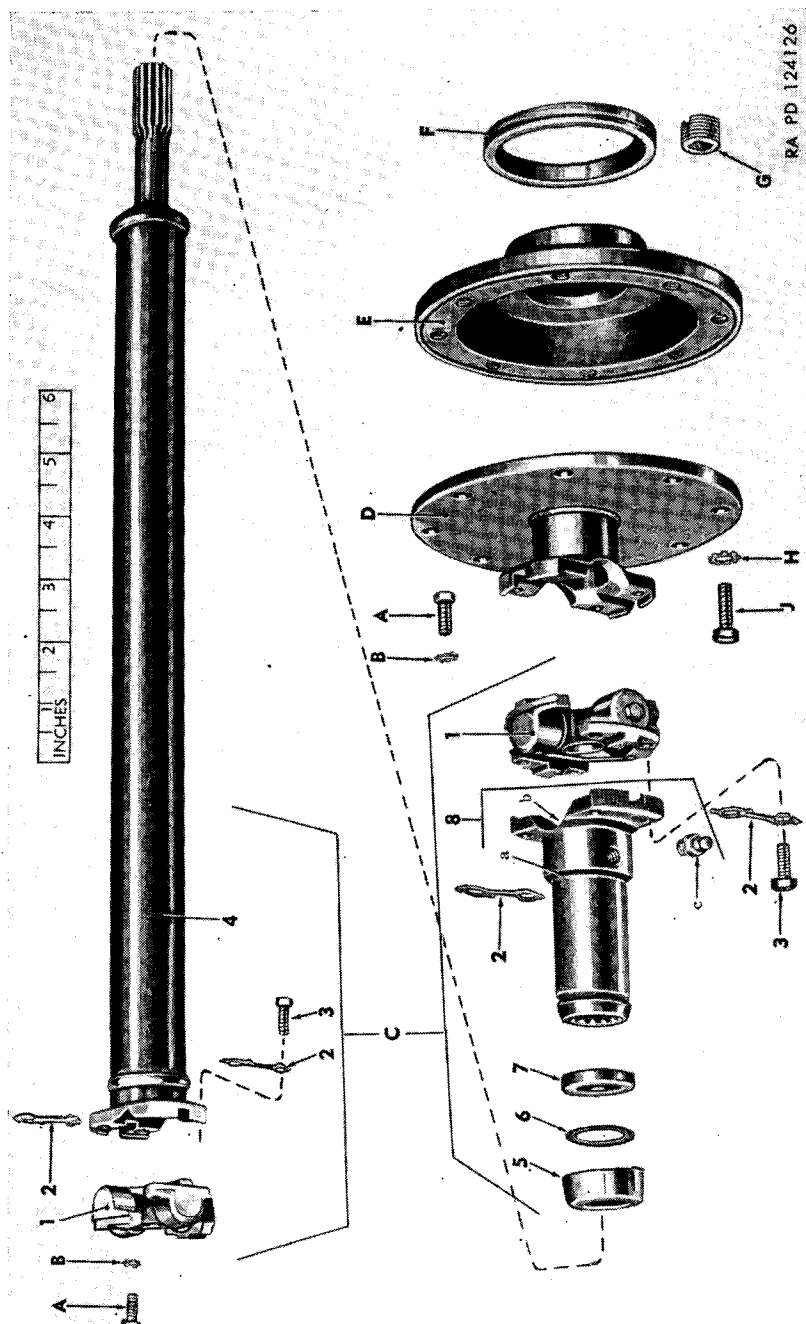


Figure 57. Hydraulic pump-propeller shaft—exploded view.

A— $\frac{5}{16}$ -24NF-2 x $\frac{3}{4}$ SCREW
 B— $\frac{5}{16}$ -IN LOCK WASHER
 C—PROPELLER-SHAFT ASSEMBLY
 1—JOURNAL
 2—LOCKING STRAP
 3— $\frac{5}{16}$ -24NF-2 x $1\frac{1}{16}$ SCREW
 4—PROPELLER SHAFT
 5—YOKE DUST CAP
 6— $1\frac{3}{8}$ -IN YOKE-CORK-RETAINING WASHER
 7— $1\frac{3}{4}$ -IN YOKE WASHER
 8—SLIP YOKE ASSEMBLY
 a—YOKE
 b—YOKE DUST CUP
 c—HYDRAULIC-TYPE LUBRICATING FITTING
 D—POWER-TAKE-OFF-COUPLING FLANGE
 E—PROPELLER-SHAFT COUPLING FLANGE
 F—COUPLING-FLANGE OIL SEAL
 G— $\frac{1}{2}$ -IN PIPE PLUG
 H— $\frac{3}{8}$ -IN LOCK WASHER
 J— $\frac{3}{8}$ -24NF-2 x 1 SCREW

Figure 57—Continued

Section XVII. HYDRAULIC-PUMP PROPELLER SHAFT

94. Removal

a. Remove the rear-rat-ion-box cover (fig. 22).

b. Remove four screws and lock washers, and disconnect the propeller-shaft journal at the front end of the shaft from the hydraulic-pump-gear-drive splined flange installed on the gear drive (fig. 57).

c. Swing the front end of the propeller shaft down and to the right, and push the shaft forward past the right end of the gear-drive case (fig. 31) to pull the male splined fitting at the back end of the shaft out of the slip yoke which holds it.

Note. The yoke washer, yoke cork-retaining washer, and yoke dust cap, will remain on the shaft (fig. 57).

d. When the shaft has been pushed far enough forward, raise the back end up and remove the shaft through the top opening of the rear-rat-ion box (fig. 31).

Note. If it is necessary to remove the propeller-shaft yoke, rear journal, and shaft-coupling flange, proceed as follows:

e. Remove the vehicle-engine left air cleaner (TM 9-718).

f. Reach into the engine compartment through the opening thus provided (fig. 26), and remove four screws and lock washers which attach the shaft journal at the rear end of the yoke (fig. 57) to the shaft-coupling flange. Pull the yoke, with journal attached, forward through the opening in the vehicle rear bulkhead, and out through the top opening of the rear rat-ion box.

g. Remove eight bolts and lock washers, and remove the shaft-coupling flange from the power-take-off-coupling flange attached to the engine (fig. 57).

95. Maintenance

a. Each of the two journals (fig. 57) is attached (one to the front end of the propeller shaft, the other to the rear end of the yoke) by four screws and two lock washers. These journals are obtainable only as complete assemblies and are not to be disassembled. If parts are worn so that the universal action of a journal is no longer smooth, or so that the two parts of a journal are loosely connected together, install a new journal.

b. Clean all parts thoroughly in dry-cleaning solvent or volatile mineral spirits paint thinner. If the yoke washer is worn, torn, or hardened, install a new washer. Replace the shaft yoke and/or coupling flange if bent, broken, or otherwise damaged.

96. Installation

a. Reach into the opening provided by the removal of the engine left air cleaner (fig. 26), position the hydraulic-pump-shaft-coupling flange against the power-take-off-coupling flange (installed on engine) and secure it with eight bolts and lock washers (fig. 57).

b. Insert the propeller-shaft yoke (with journal attached) down through the rear ration box and back through the circular opening in the vehicle rear bulkhead. Secure the journal to the shaft-coupling flange with four screws and lock washers.

c. Lower the front of the propeller shaft (with journal attached) down into the rear ration box. Push the front end forward, to the right and below the end of the hydraulic-gear-drive case, until the rear end is also in the box, then push the rear end backward (with the yoke washer, yoke cork-retaining washer, and yoke dust cap on the end of the shaft) to engage the male splined fitting at the rear end of the shaft with the female splined fitting in the yoke. Push the shaft backward until the fittings are entirely engaged, then reach through the circular opening in the vehicle rear bulkhead and push the yoke dust cap backward on the shaft until it is engaged in the groove at the front end of the yoke.

d. Secure the journal at the front end of the shaft (C1, fig. 57), to the hydraulic-pump-gear-drive splined flange with four screws and lock washers.

e. Lubricate the propeller shaft (fig. 47).

Section XVIII. HYDRAULIC-PUMP OIL RESERVOIR AND MOUNTING PLATE

97. Hydraulic-Pump Oil Reservoir

a. REMOVAL.

- (1) Remove the hydraulic-pump control valve (par. 89).
- (2) Remove two screws and lock washers which secure left floor plate, and remove the plate from above the oil reservoir (fig. 40).
- (3) Remove four screws and lock washers which secure the oil reservoir to the mounting plate (fig. 58).
- (4) Remove the pipe plug from the drain-outlet flange (fig. 58) and drain all oil from the reservoir into a 16-gallon can placed under the vehicle.
- (5) Place a crowbar between the front end of the reservoir and the front bulkhead to slide the reservoir to the rear on its mounting plate. While pushing the reservoir backwards, disconnect the hydraulic-pump-to-reservoir hose from the adapter union installed in the reservoir (fig. 32).
- (6) Remove the adapter union just disconnected from the hose.
- (7) Remove the filler cap, gasket, filler-cap adapter, and the pipe nipple (with the pipe-straight elbow attached) from the oil reservoir (fig. 58).
- (8) Raise the oil reservoir straight up to the level of the compartment floor and turn it to rest on its left side with the end which was towards the front of the vehicle on top of the front bulkhead and the rear end on top of the rear bulkhead.

Note. By swinging the front of the reservoir to the right, it can be made to rest in this position.

- (9) Remove four screws which secure the drain-outlet flange and remove the flange together with the gasket from the bottom of the reservoir.
- (10) Position the turret with the 90-mm gun pointing 90 degrees right (TM 9-718), then up-end the reservoir and pass it out through the hatch opening which will be at the front of the turret compartment.

Note. The reservoir will have to be jockeyed back and forth to pass the pads welded to the side of the reservoir through the hatch opening. As the reservoir is quite heavy, a hoist sling should be hooked to the handle at the front end of the reservoir, and two operators should be stationed inside of the vehicle to maneuver the reservoir for removal.

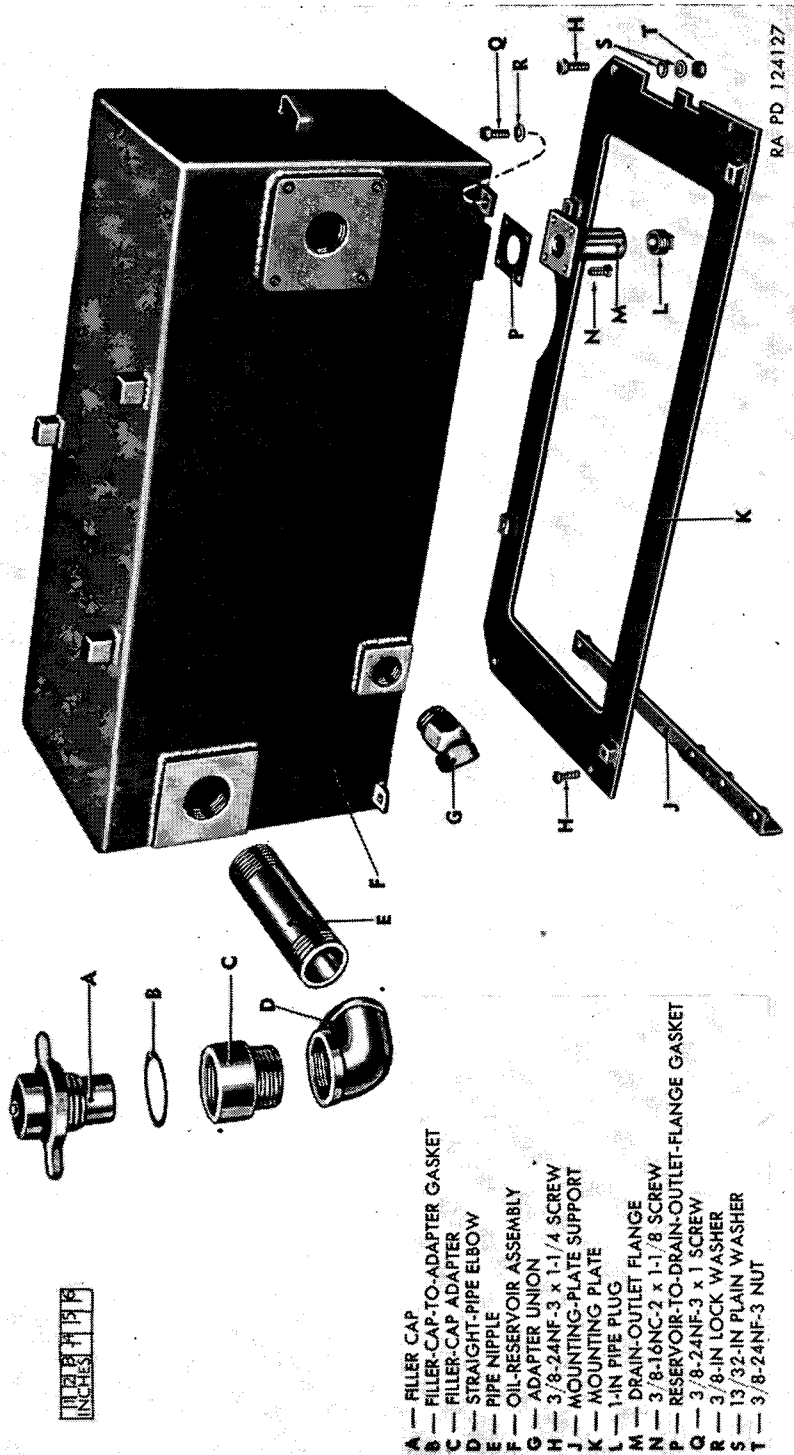


Figure 58. Hydraulic-pump oil reservoir and mounting plate—exploded view.

b. INSTALLATION.

- (1) Attach a hoist sling to the handle (which is at the front end of the reservoir), station two operators inside the turret compartment, position the vehicle turret with the 90-mm gun pointing 90 degrees to the right (TM 9-718), and lower the reservoir into the turret compartment through the hatch which will now be at the front of the compartment.

Note. It will be advisable to have two operators inside of the compartment to jockey the reservoir so that the pads welded to the side of the reservoir can be made to clear the hatch opening, and to handle the reservoir as it is lowered into the compartment.

- (2) Position the reservoir inside the compartment with the end having the welded-on handle at front (fig. 58), with the side having the two mounting pads at top, and with the reservoir "cocked" so that the front end is resting on top of the front bulkhead and the rear end is resting on top of the rear bulkhead.
- (3) Place the drain-outlet-flange-to-reservoir gasket over the mounting pad which is close to the front on the right side, and install the drain-outlet flange over the gasket, securing it in place with four screws and lock washers (fig. 58).
- (4) Turn the reservoir to place the drain-outlet flange at bottom and the side having the two mounting pads at the right. Lower the reservoir into place on top of its mounting plate.
- (5) Install the pipe nipple with straight elbow attached in the threaded hole at the rear end of the right side of the reservoir, tightening the nipple to place the elbow so that it points straight up. Install the filler-cap adapter, gasket, and filler cap in the elbow (fig. 58).
- (6) Install the adapter union in the threaded hole on the lower edge of the right side of the reservoir (fig. 32), tightening the union so that it points to the right front.
- (7) Move the reservoir far enough to the rear to start the adapter union over the pump-to-reservoir hose (fig. 32).

Note. Use a crowbar between the back end of the reservoir and the rear bulkhead to push the reservoir forward so that the union can be tightened onto the hose. It will be necessary to raise the reservoir up while pushing it forward so that the mounting pads at the bottom edges of the reservoir will be on top of the mounting blocks welded to the mounting plate.

- (8) Aline the bolt holes in the mounting pads of the reservoir with the threaded holes of the mounting blocks on the mounting plate (fig. 30), and secure the reservoir in place with four screws and lock washers.

- (9) Install the hydraulic-pump control valve (par. 89).
- (10) Install the left floor plate over the reservoir and secure it to the mounting blocks with two screws and lock washers (fig. 40).
- (11) Install the pipe plug in the drain-outlet flange, and fill the reservoir according to lubrication order (fig. 47).

98. Hydraulic-Pump-Reservoir Mounting Plate

a. REMOVAL.

- (1) Remove the hydraulic-pump oil reservoir (par. 97).
- (2) Remove four screws, washers, and nuts, and remove the mounting plate from the vehicle (fig. 58).

Note. The plate can easily be passed out of either hatch opening of the turret compartment.

b. INSTALLATION.

- (1) Lower the plate through either hatch opening into the turret compartment, and position it at the bottom-left side of the open area in which the hydraulic pump is installed, placing the edge with the cutaway portions to the front.

Note. The cutaway portions in the front edge fit around obstructions at the rear side of the front bulkhead and, when the mounting plate is properly positioned, the bolt holes at the four corners of the plate will be alined with the bolt holes in the floor supports under the front and rear edges of the plate.

- (2) Secure the plate in position with four screws, washers, and nuts (fig. 58).
- (3) Install the hydraulic-pump oil reservoir (par. 97).

CHAPTER 4

FIELD AND DEPOT MAINTENANCE INSTRUCTIONS

Section I. PARTS, SPECIAL TOOLS, AND EQUIPMENT FOR FIELD AND DEPOT MAINTENANCE

99. General

Tools and equipment and maintenance parts over and above these available to the using organization are supplied to ordnance field maintenance units and depot shops for maintaining, repairing, and/or rebuilding the matériel.

100. Parts

Maintenance parts are listed in Department of the Army Supply Catalog ORD 7-8 SNL G-246, which is the authority for requisitioning replacements. Parts not listed in the ORD 7-8 catalog, but required by depot shops in rebuild operations, may be requisitioned from the listing in the corresponding ORD 9 catalog and will be supplied if available.

101. Common Tools and Equipment

Standard and commonly used tools and equipment having general application to this matériel are authorized for issue by T/A or T/O & E. They are not specifically identified in this manual.

102. Special Tools and Equipment

No special tools and equipment are authorized for ordnance maintenance.

103. Improvised Tools

The improvised tools listed in table V and the dimensioned detail drawings are furnished to enable field and depot maintenance organizations to fabricate these tools locally, if desired. The chief value of these tools is to maintenance organizations engaged in rebuilding a large number of components. These tools are not essential for rebuild

and are not available for issue; the data is furnished for information only.

Table V. Improvised Tools for Field and Depot Maintenance

Item	References		Use
	Fig.	Par.	
PLATE.....	59	110, 114	To hold hydraulic pump for bench work.
REMOVER, bearing, wedge-type.	59, 61	110	To raise hydraulic-pump bearings to permit use of puller.
PULLER, bearing.....	59, 62	110	To remove hydraulic-pump bearings.
REPLACER, oil-seal-seat...	59	114	To install hydraulic-pump oil-seal seat.
REPLACER, bearing.....	59	114	To install hydraulic-pump bearings.

Section II. REPAIR AND REBUILD OF CONTROL VALVE

104. Disassembly

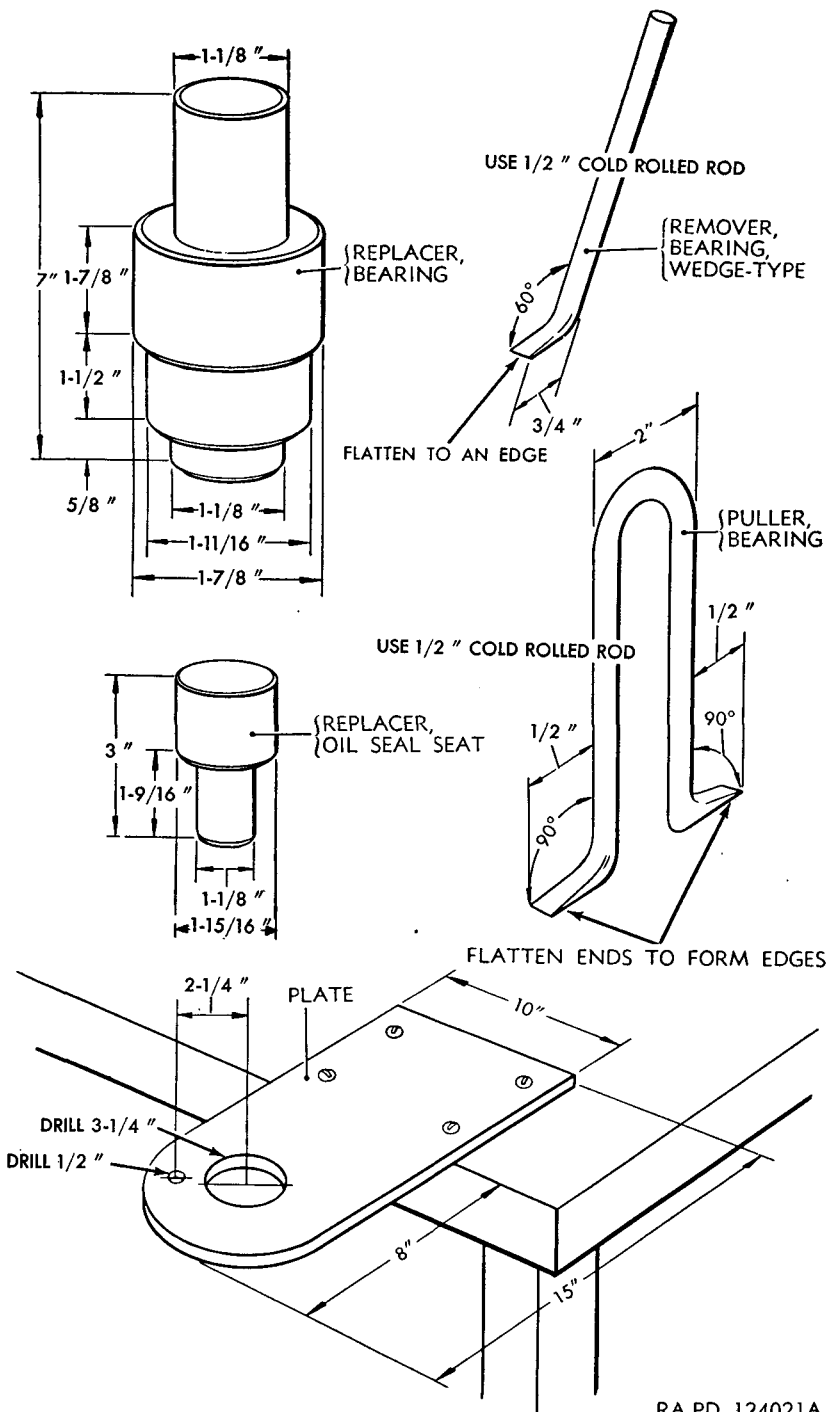
(fig. 60)

a. REMOVE CAM-STOP HEAD.

- (1) Remove the four pipe plugs from the unused ports.
- (2) Drive out the taper pin which secures the valve-stem head to the rotor shaft, and remove the valve-stem head.
- (3) Remove the cam-stop-head cap and screw out the relief-valve adjusting screw.
- (4) Remove the six screws which secure the cam-stop head to the body.
- (5) Remove the cam-stop head and gasket.
- (6) Turn the body to place the side which is now open down, and tap out the rotor assembly, with the ball bearing at the bottom end still on the rotor. Use a block of wood turned down to fit the port opening in the inlet head.

b. REMOVE THE INLET HEAD.

- (1) Remove the six screws which secure the inlet head to the body.
- (2) Remove the inlet head and gasket.
- (3) Turn the body to place the inlet-head side down to permit the relief valve and relief-valve spring to drop out.
- (4) With the body still in this position, tap out the remaining ball bearing, using a block of wood turned down to fit the rotor bore in the body.



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Figure 59. Improvised tools.

c. REMOVE CHECK VALVES.

- (1) Remove the check-valve cap.
- (2) Turn the body to place the cap opening down to permit the check-valve-pusher spring, inner check valve, outer check valve, and check-valve pusher to drop out.

d. REMOVE CAM ROLLER.

- (1) Remove the cam-roller-plunger cap.
- (2) Turn the body to place the cap opening down to permit the cam-roller-plunger spring and the cam-roller plunger, with the cam roller attached to drop out.
- (3) Drive the cam roller pin out of the plunger and remove the cam roller from the plunger.

e. DISASSEMBLE ROTOR ASSEMBLY.

- (1) Remove the ball bearing from the rotor, using a small arbor press.
- (2) Drive out the taper pin and separate the rotor shaft from the rotor.

105. Cleaning

Wash all parts thoroughly with dry-cleaning solvent or volatile mineral spirits paint thinner, and dry with filtered compressed air. Particularly clean out the relief-valve and check-valve bores in the valve body.

106. Inspection

Check to see that parts are within the limits of the repair and rebuild standards (par. 140) and replace any parts that are excessively worn or damaged. Inspect housing parts for cracks or damage to machined surfaces and threaded ports, and replace any parts that are damaged. Inspect all three springs. Each should stand erect when placed on end and should meet the free-length requirement (par. 140). Replace springs which do not meet these requirements.

107. Repair and Rebuild

Using a valve grinder and a fine valve-grinding compound, reseal the relief valve in the relief-valve seat located inside the inlet head. Reseat the outer check valve in the check-valve seat located inside the valve body. Reseat the inner check valve in the inner-check valve seat located inside the check valve. Wash out all valve-grinding-compound residue with dry-cleaning solvent or volatile mineral spirits paint thinner and dry parts with filtered compressed air.

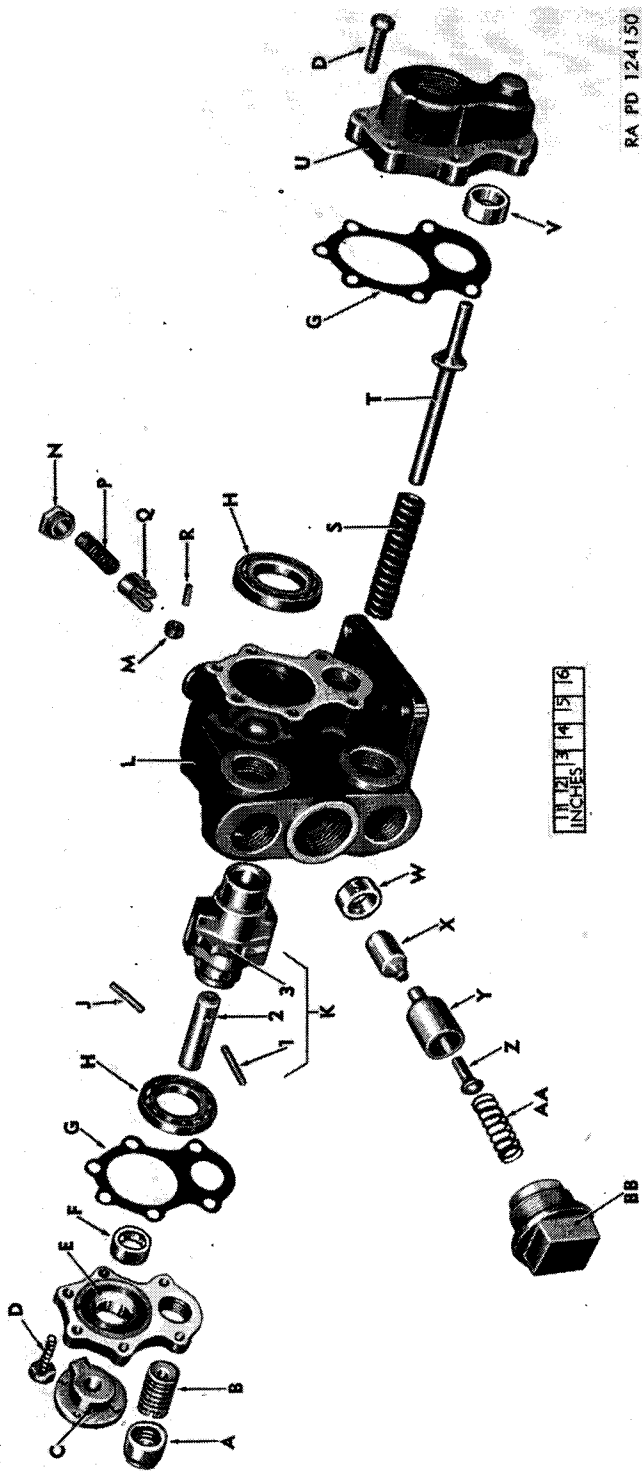


Figure 60. Control valve—exploded view

A—CAP, CAM-STOP-HEAD—7323512
 B—SCREW, ADJUSTING, RELIEF-VALVE—7323513
 C—HEAD, VALVE-STEM—7323528
 D—SCREW, $\frac{3}{8}$ -16NC-3 x $1\frac{1}{8}$ —180123
 E—HEAD, CAM-STOP—7323531
 F—SEAL, OIL—500226
 G—GASKET (CAM-STOP-HEAD-TO-VALVE-BODY (1), INLET-HEAD-TO-VALVE-BODY (1))—7323526
 H—BEARING, BALL (ROTOR)—700072
 J—PIN, TAPER, 0.289 x $1\frac{1}{2}$ -IN—103616
 K—ROTOR ASSEMBLY—7323510
 1—PIN, TAPER, 0.289 x $1\frac{3}{4}$ -IN—103617
 2—SHAFT, ROTOR—7323507
 3—ROTOR—7323509
 L—BODY—7323506
 M—ROLLER, CAM—7323530
 N—CAP, CAM-ROLLER-PLUNGER—7323508
 P—SPRING, CAM-ROLLER-PLUNGER—7323536
 Q—PLUNGER, CAM-ROLLER—7323527
 R—PIN, CAM-ROLLER—7323529
 S—SPRING, COMPRESSION (RELIEF VALVE)—7323535
 T—VALVE, RELIEF—7323514
 U—HEAD, INLET—7323532
 V—SEAT, RELIEF VALVE—7323516
 W—SEAT, OUTER-CHECK-VALVE—7323524
 X—PUSHER, CHECK-VALVE—7323523
 Y—VALVE, CHECK, OUTER—7323511
 Z—VALVE, CHECK, INNER—7323515
 AA—SPRING, COMPRESSION (CHECK-VALVE-PUSHER)—7323537
 BB—CAP, CHECK VALVE—7323525

Figure 60—Continued

108. Assembly

(fig. 60)

a. GENERAL. Carefully clean all parts prior to assembly to make certain that they are free from abrasives and foreign material of any kind.

b. INSTALL INLET HEAD.

- (1) Install one ball bearing into the inlet-head side of the rotor bore in the body, using a small arbor press. Seat the bearing firmly against the shoulder in the body.
- (2) Insert the relief-valve spring and the relief valve into the relief-valve bore in the body, inserting these parts from the inlet-head side of the body.
- (3) Place a new gasket over the machined surface at the inlet-head side of the body.
- (4) Position the inlet head over the gasket, and secure it in place with six screws.

charge from the bottom of the control valve should cease entirely, and the oil pressure gage reading should rise rapidly to 1,000 psi. When the reading reaches 1,000 psi it should become stationary, and the control valve should discharge the full output of the pump into the reservoir. Readjust the relief valve, if necessary, to obtain this result. Close gate valve No. 2. There should be no change in the amount of oil being discharged into the reservoir.

- (6) Move the control-valve-stem head an additional one-third of its total travel to the "hold" position and open both gate valves. The oil pressure gage reading should remain indefinitely at 1,000 psi, and the control valve should continue to discharge the full output of the pump into the reservoir. If pressure drops slowly, check valves are improperly seated. Reseat them (par. 107).
- (7) Move the control-valve-stem head to the foremost or "raise" position. Pressure will drop rapidly to zero.
- (8) Leave gate valve No. 1 open and close gate valve No. 2. The oil pressure gage reading should rise rapidly to 1,000 psi then remain stationary, and the control valve should discharge the full output of the pump into the reservoir (same as in step (5)).
- (9) Repeat steps (4) through (8) several times to thoroughly test operation of the control valve. End test and certify control valve for installation in a vehicle.

Section III. REPAIR AND REBUILD OF HYDRAULIC PUMP

110. Disassembly

(fig. 63)

a. MARK HOUSING SECTIONS. Using a prick punch, mark both sides of the pump housing and the two covers so that these three parts can be assembled in the original positions.

b. REMOVE OPPOSITE-ADAPTER-END COVER.

- (1) Turn the pump with the adapter-end cover down and bolt it to the improvised plate (fig. 59).
- (2) Remove the 12 nuts, washers, and screws which attach the two covers to the pump housing.
- (3) Lift off the cover.

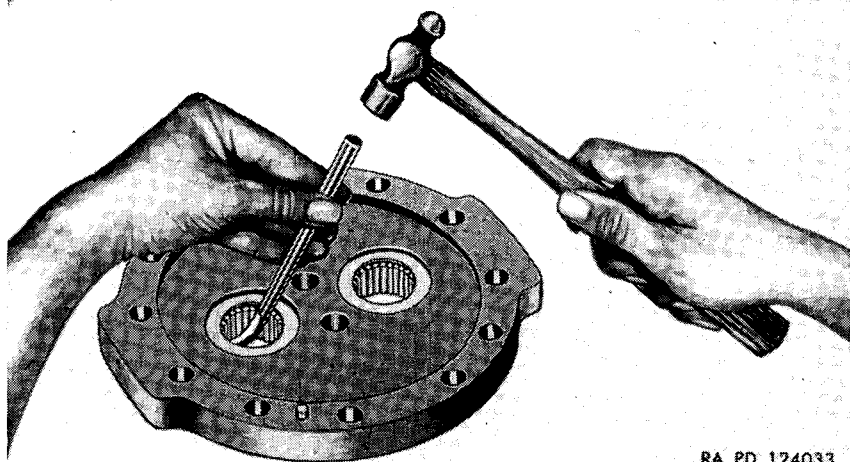
Note. The wear plate at this end of the pump will remain on top of the gears, and the two check-valve plungers and the two check-valve-plunger springs will drop out of the cover when it is removed.

- (4) Mark the wear plate with blue aniline dye to assure proper assembly, and lift it off of the gears.

- (5) Remove and discard the vellum gasket which separated the cover from the housing.
- c. REMOVE GEARS AND SHAFTS.
 - (1) Mark the tops of the two gears and shafts with blue aniline dye to assure proper assembly.
 - (2) Simultaneously lift the two gears and their shafts out of the housing.
 - (3) Lift the oil-seal spring out of the drive-shaft bore in the adapter-end cover.
- d. REMOVE HOUSING.
 - (1) Lift the housing off the adapter-end cover.
 - (2) Mark the wear plate that remains on top of the adapter-end cover with blue aniline dye to assure proper assembly.
 - (3) Lift the wear plate off the adapter-end cover.
 - (4) Lift the two check-valve plungers and two plunger springs out of the bores in the adapter-end cover.
- e. REMOVE BEARINGS FROM COVERS.

Note. There are two needle bearings in each cover. All four are removed in the same manner.

- (1) Start bearing up out of its bore, using the improvised wedge-type bearing remover (figs. 59 and 61).
 - (2) Remove bearing, using the improvised bearing puller (figs. 59 and 62).
- f. REMOVE OIL SEAL.
- (1) Remove the adapter-end cover from the improvised plate.
 - (2) Invert the cover and tap outer end with a plastic hammer or rawhide mallet until the oil-seal retainer drops out.



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Figure 61. Raising hydraulic-pump bearing using improvised wedge-type bearing remover.

c. INSTALL ROTOR.

- (1) Install the remaining ball bearing on the rotor using a small arbor press. Push it all the way on.
- (2) Insert the rotor shaft into the end of the rotor, and install the $1\frac{3}{4}$ -inch taper pin to hold the shaft in place.
- (3) Hold the rotor assembly so that the shaft end is toward the cam-stop head, and rotate it so that the cam face which has three distinct detent positions (these detents are curved to match the small-diameter contour of the cam roller) will be facing that side of the body which holds the cam roller.
- (4) Insert the rotor assembly into the body, fitting the inlet-head end of the rotor into the bearing already installed in the body. Using a plastic hammer or rawhide mallet tap the assembly into the body until the bearing on the rotor is firmly seated.
- (5) Without rotating the rotor, place a new gasket over the machined surface of the body, position the cam-stop head over the gasket, and secure the head in place with six screws.
- (6) Still without rotating the rotor, install the valve-stem head over the end of the rotor shaft, positioning this head so that it can be secured in place with the $1\frac{1}{2}$ -inch taper pin.
- (7) Install the taper pin.

Note. If original parts are installed, the taper pins will make it impossible to position the rotor incorrectly with respect to the valve-stem head. When new parts are installed, the taper pin bores must be reamed for installation of the taper pins, and care must be exercised not to turn the rotor 180° with respect to the valve-stem head. Any movement of the rotor assembly during assembly will result in improper installation.

d. INSTALL CHECK VALVES.

- (1) Insert the check-valve pusher, small diameter end first, into the check-valve bore of the body.
- (2) Place the inner check valve inside the outer check valve and seat it properly.
- (3) Insert the outer check valve, small diameter end first, into the body bore, on top of the pusher.
- (4) Place the check-valve-pusher spring on top of the inner-check-valve head inside the outer check valve.
- (5) Install the check-valve cap.

e. INSTALL CAM ROLLER.

- (1) Place the cam roller between the bosses of the cam-roller plunger.
- (2) Install the cam-roller pin.
- (3) Insert the plunger and roller, roller end first, into the cam-roller bore of the body.

- (4) Insert the cam-roller-plunger spring into the bore.
- (5) Install the cam-roller-plunger cap.
- (6) Install four pipe plugs in the four ports at the sides of the projecting front portion of the valve body.

109. Test and Adjustments

a. ADJUST RELIEF VALVE.

- (1) Install the relief-valve adjusting screw into the cam-stop-head side of the relief-valve bore in the body (fig. 60).
- (2) Adjust the screw to obtain a relief-valve pressure setting of 1,000 psi.

Note. If bench equipment (*b* below) for adjusting the relief valve is not available, adjustment can be made while the control valve is installed in the vehicle. Set the relief valve so that it will not open while the moldboard is being raised, but so that it will open immediately after the moldboard has reached its extreme raised position.

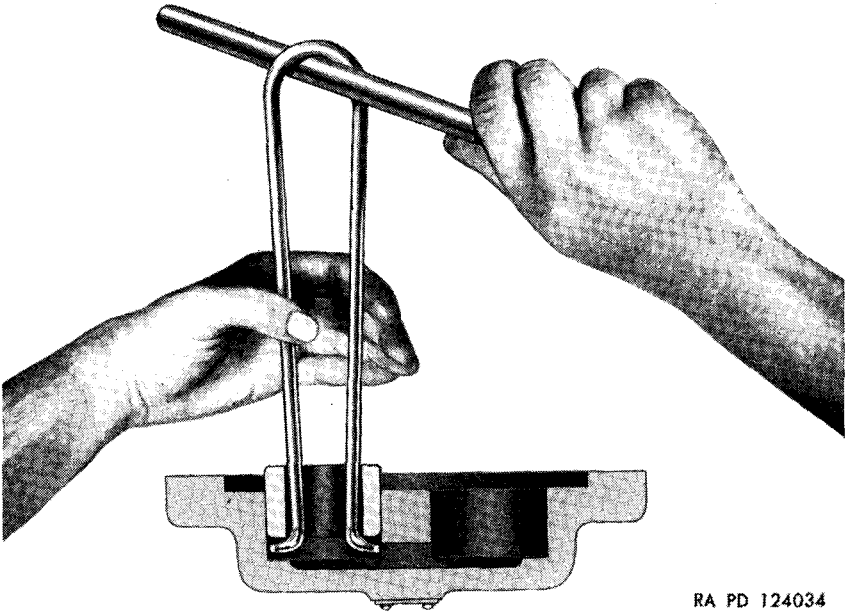
- (3) Install the cam-stop-head cap.

b. TEST OPERATION OF CONTROL VALVE.

- (1) Use a hydraulic pump and oil reservoir and connect the pump, reservoir, and control valve as they are when installed in the vehicle (fig. 32).

Note. Do not install the control valve on the reservoir; instead, support it on blocks above the reservoir mounting pad so that oil can drip (or flow) out the bottom opening of the valve into the reservoir, and so that any such drip (or flow) can be seen.

- (2) Connect two hydraulic lines to the two outer ports at the front of the control valve. Connect the end of each line to a gate valve, and connect an oil pressure gage between the two gate valves (to indicate the oil pressure in the interconnecting line). Select the gate valve in the line connected to the control-valve port at the left and label it No. 1. Label the other gate valve No. 2.
- (3) Operate pump at 1,200 rpm with both gate valves open.
- (4) Position control-valve-stem head to rearmost or "float" position. Full output of hydraulic pump should be discharged from bottom of control valve into reservoir. Close one gate valve alone, then open this valve and close the other gate valve alone. Finally, close both gate valves simultaneously. There should be a zero pressure reading on the gage, and no change in the amount of oil being discharged by the control valve into the reservoir.
- (5) Open gate valve No. 2 alone and move the control-valve-stem head $\frac{1}{3}$ of its total travel to the "lower" position. The dis-



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Figure 62. Removing hydraulic-pump bearing using improvised bearing puller.

- (3) Drive the oil seat out of the adapter-end cover by using a block of wood turned down to exactly fit the seat bore in the cover.
- (4) Lift the oil-seal retaining ring and oil seal out of the retainer.

g. REMOVE GEARS FROM SHAFTS.

Note. Both gears are "push" fits on their shafts (par. 139).

- (1) Remove snap rings from each end of driven shaft, using snap-ring pliers.
- (2) Press gear off driven shaft, using a small arbor press.

Caution: Do not hammer gear or shaft as even slight "scars" will destroy usefulness of these parts.

- (3) Remove snap rings and gear from drive shaft in same manner.

Note. This gear is keyed to its shaft.

Lift key from slot in shaft.

111. Cleaning

Wash all parts in dry-cleaning solvent or volatile mineral spirits paint thinner, and remove all gasket material that may remain on the housing, covers, or wear plates. Dry parts with filtered compressed air.

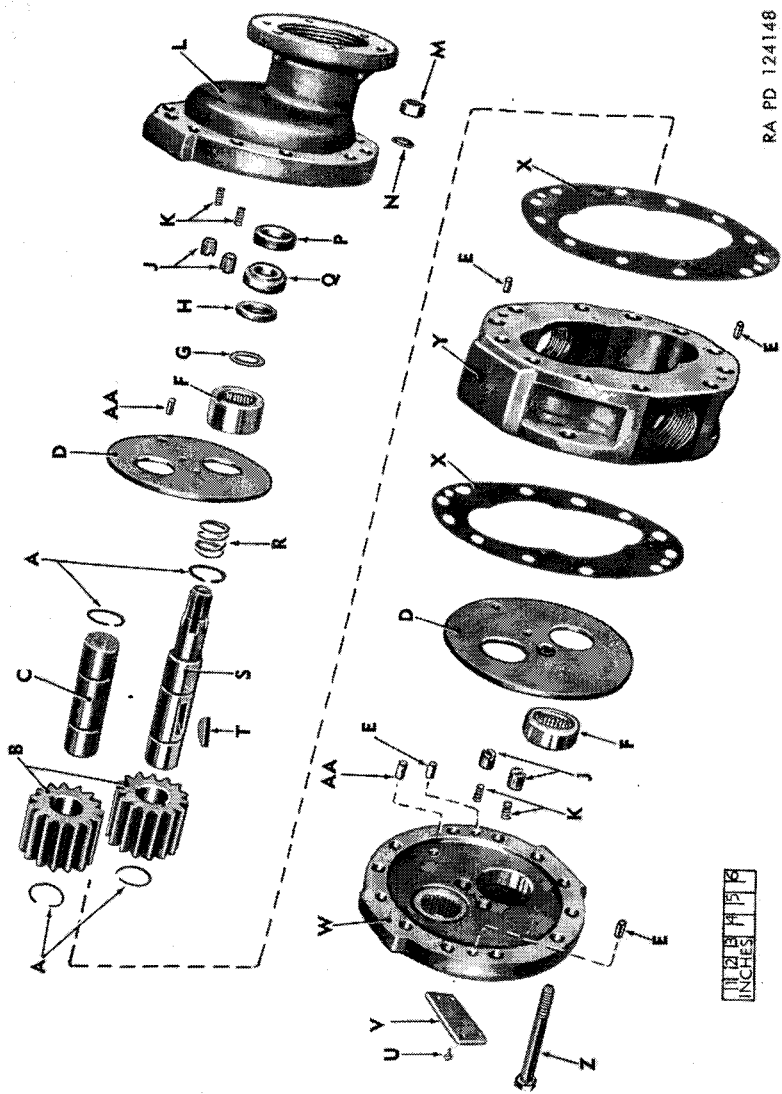


Figure 63. Hydraulic pump—exploded view.

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A—RING, SNAP—HDE-812X46
 B—GEAR—HDE-J30-6-25
 C—SHAFT, DRIVEN—HDE-L30-5-25
 D—PLATE, WEAR—HDE-J30-12
 E—DOWELL—HDE-A551X6
 F—BEARING, NEEDLE—HDE-A340X15
 G—RING, RETAINING, OIL-SEAL—HDE-A408X47
 H—SEAL, OIL, DRIVE-SHAFT—HDE-30-10RA
 J—PLUNGER, CHECK-VALVE—HDE-513X11
 K—SPRING, COMPRESSION (CHECK-VALVE-PLUNGER)—HDE-A501X29
 L—COVER, W/INTEGRAL ADAPTER—HDE-9P30-2
 M—NUT, $\frac{1}{2}$ -20NF—HDE-A238X5
 N—WASHER, PLAIN, $1\frac{7}{32}$ -IN—HDE-A419X8
 P—SEAT, OIL-SEAL—HDE-J30-11BK
 Q—RETAINER, OIL-SEAL—HDE-30-10C
 R—SPRING, COMPRESSION (OIL-SEAL)—HDE-A501X159
 S—SHAFT, DRIVE—HDE-9P30-4-25
 T—KEY, $\frac{1}{4} \times 1\frac{1}{2}$ —HDE-A258X34
 U—SCREW, 0.0995 x 0.114 x $\frac{3}{16}$ —HDE-A386X10
 V—PLATE, NAME—HDE-A475X
 W—COVER—HDE-AM30-3
 X—GASKET, SHIM-TYPE—HDE-30-14
 Y—HOUSING, PUMP—HDE-30-1-25
 Z—SCREW, $\frac{1}{2}$ -20NFX5—HDE-A439X11
 AA—DOWEL, WEAR-PLATE—HDE-A 551X33

Figure 63—Continued

112. Inspection

Examine the two gears, two shafts, two wear plates, four needle bearings, and the parts of the oil seal for damage and wear (par. 141). All damaged or excessively worn parts must be replaced with new parts.

113. Repair and Rebuild

Remove any nicks or burrs which may be on the machined surfaces of the housing or covers. Break the edge of the shoulder in the adapter-end cover on which the seal seat rests, by using a scraper.

114. Assembly

(fig. 63)

a. INSTALL GEARS ON SHAFTS.

Note. Whenever either gear is excessively worn, it is generally advisable to replace both gears, instead of just the one, as these parts must be carefully mated to function properly.

- (1) Place one snap ring in the groove at one end of the drive shaft, using snap-ring pliers.
- (2) Select the gear for the drive shaft in accordance with dye

marks made during disassembly, and coat the gear bore with white lead pigment.

- (3) Press gear onto shaft using a small arbor press. Insert the key into the shaft slot and seat the gear properly on it. Press gear down to touch the snap ring.

Caution: Do not hammer gear or shaft as even slight "scars" will destroy usefulness of these parts.

- (4) Install snap ring at other end of shaft.
- (5) Install gear on driven shaft in same manner, except that there is no key between gear and shaft.

b. INSTALL OIL SEAL.

- (1) Turn the adapter-end cover with the small flange down and bolt it to the improvised plate (fig. 59).
- (2) Install a new oil-seal seat into the drive-shaft bore of the adapter-end cover. To install seat, position it at the top of the bore with the lapped surface of the seat up, and aline it carefully with the bore. Drive it into the bore using the improvised oil-seal-seat replacer (fig. 59). Drive it all the way down into the bore.
- (3) Insert a new oil seal into the oil-seal retainer and place the oil-seal retaining ring on top of the seal inside the retainer.
- (4) Insert the retainer with the open end up into the drive-shaft bore in the adapter-end cover, and push it down onto the oil seat.

c. INSTALL BEARINGS IN COVERS.

Note. There are two needle bearings to be installed in each cover. All four are installed in the same manner.

- (1) Place bearing at top of its bore and aline it carefully with the bore.
- (2) Drive the bearing into its bore, using the improvised bearing replacer (fig. 59). Push it all the way into the bore.

d. INSTALL GEARS AND HOUSING.

- (1) Insert the two check-valve-plunger springs into the plunger bores in the adapter-end cover.
- (2) Insert the two check-valve plungers with the slotted ends of the plungers up into the bores on top of the springs.
- (3) Place the wear plate removed from this end on top of the adapter-end cover.

Note. Wear plate can be identified and can be properly positioned by noting the dye marks made during disassembly.

Aline the plate with the locating dowels in the cover, and press it down to compress the check-valve-plunger springs.

Caution: Make certain that plungers properly enter their bores as the wear plate is lowered on top of them.

- (4) Insert the oil-seal spring into the drive-shaft bore in the adapter-end cover.
- (5) Insert the drive shaft with splined end down into the bore on top of the spring.
- (6) Position the two gears so that they will be mated in accordance with dye marks made during disassembly, and insert the driven shaft into its bore in the adapter-end cover.
- (7) Place a new gasket on the machined surface of the adapter-end cover.
- (8) Lower the housing onto the adapter-end cover (fig. 64), positioning it in accordance with punch marks made during disassembly. Locate it over the dowel pins in the cover and seat it firmly on top of the gasket.

Note. The drive shaft will stand up approximately $\frac{1}{2}$ inch above the driven shaft due to the oil seal spring. When the spring is compressed during installation of the opposite-adapter-end cover (*e* below), the gap will be eliminated.

e. INSTALL OPPOSITE-ADAPTER-END COVER.

- (1) Place a new gasket on the machined surface of the housing.
- (2) Hold a straightedge diametrically across the top of the housing so that it touches the housing at each side of the driven gear and passes over the driven gear. Measure the clearance between the straightedge and driven gear with a feeler gage (fig. 65). This clearance should be 0.008 to 0.0010 inch.
- (3) Add or remove shim-type gasket as required to obtain this clearance.
- (4) Place opposite-adapter-end cover on bench with inner side up.
- (5) Insert the two check-valve-plunger springs into the plunger bores in the cover.
- (6) Insert the two check-valve plungers with the slotted ends up into the bores on top of the springs.
- (7) Place the remaining wear plate on top of the cover, alining it in accordance with dye marks made during disassembly.
- (8) Hold a straightedge across the cover to keep the wear plate in place, invert the cover, and lower it into position (fig. 66) on the housing. Locate it on housing in accordance with punch marks made during disassembly, slide the straightedge out of the way, and aline the dowel pins in the cover with the bores in the housing.

Note. Cover must be pushed down firmly to compress the oil-seal

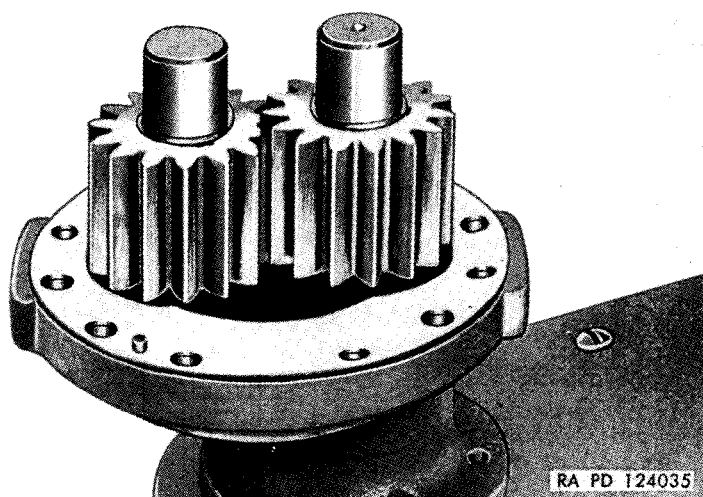
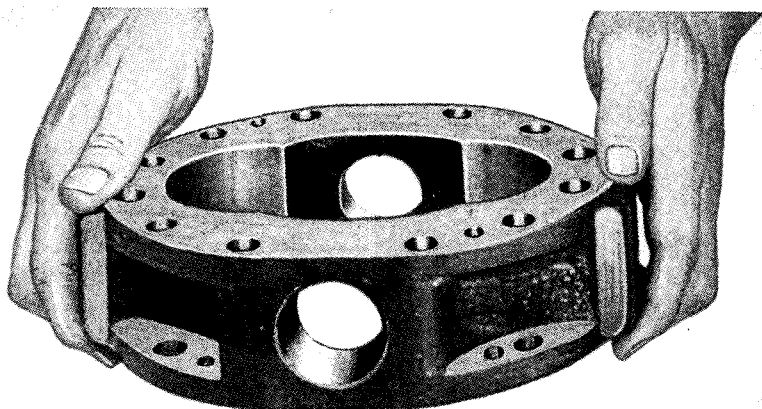


Figure 64. Installing hydraulic-pump housing onto adapter-end cover.

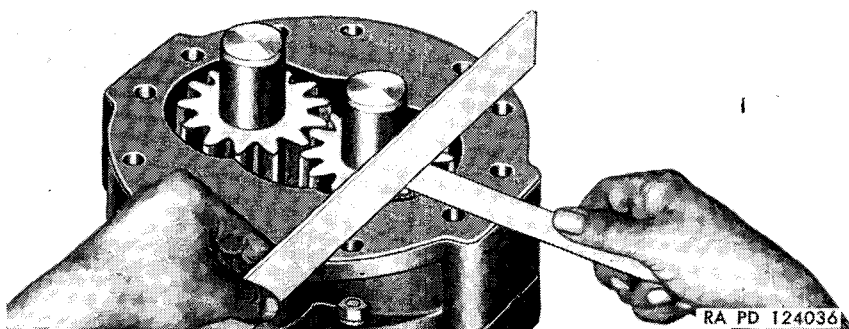
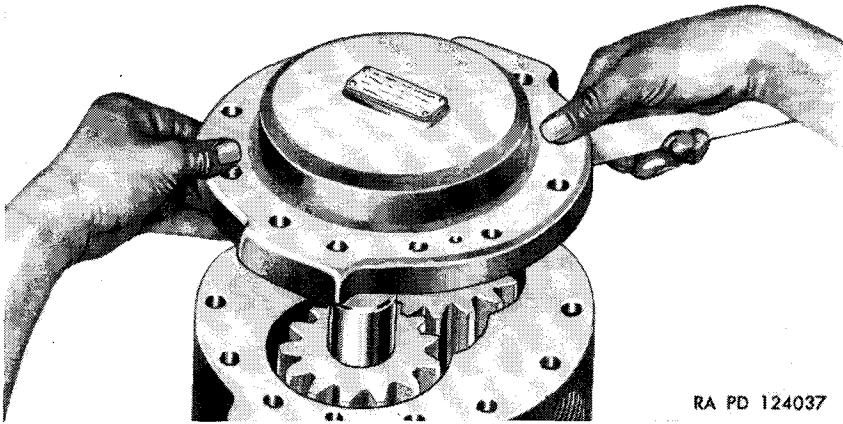


Figure 65. Measuring thickness of shim-type gasket under hydraulic-pump cover.



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Figure 66. Installing hydraulic-pump cover.

spring. If the two gear shafts are correctly positioned, the cover bearings will slip easily down over the shafts as cover is lowered.

Caution: Do not force cover down, rather jockey it until it fits easily over the housing.

- (9) Install 4 of the 12 screws to secure covers to the housing, placing these in evenly spaced positions approximately 90° apart. Install washers and nuts and tighten nuts evenly with a torque wrench set at 90-to-110-foot-pounds torque.
- (10) Rotate drive shaft. If it cannot be rotated readily by hand, remove cover, install another shim-type gasket between cover and housing, and repeat (4) through (10).
- (11) Install remaining eight screws, washers, and nuts. Tighten nuts with a torque wrench set at 90-to-100-foot-pounds torque.

115. Test and Adjustments

a. PREPARATION FOR TEST.

- (1) Mount pump securely and provide a means for driving it at tachometer speeds (taken at pump drive shaft) of 200, 600, and 1,200 rpm.
- (2) Provide a reservoir full of hydraulic oil (fig. 47) and connect inlet side of pump to an intake pipe or hose arranged to draw oil from bottom of reservoir.
- (3) Connect outlet side of pump to an adjustable-pressure valve set to open at 1,000 psi pressure and having a by-pass with free discharge into the reservoir.

Note. A spare hydraulic-pump control valve, properly adjusted, can be used. Connect outlet side of pump to opening in valve opposite the valve-stem head (fig. 60). Install pipe plugs in all other ports except

opening in bottom of valve and mount valve on top of the oil reservoir with free discharge from bottom opening into reservoir.

- (4) Provide a thermometer for testing temperature of oil in reservoir.

b. TEST AND RUN-IN.

- (1) Open valve so that pump discharge will flow freely into reservoir.

Note. If hydraulic-pump control valve is used, move the valve-stem head to the "hold" position ($\frac{2}{3}$ of total travel from rearmost position).

- (2) Operate pump at 200 rpm for 10 minutes, or longer if necessary to raise oil temperature to approximately 90° F.
- (3) Close valve so that pump operates against valve pressure setting.

Note. If control valve is used, move the valve-stem head to the "raise" position (foremost position).

- (4) Allow pump to build up enough pressure to open the valve (1,000 psi), and to pump against this pressure for approximately 10 seconds.
- (5) Open valve for 5 seconds ((1) above), then repeat (3) and (4) above.
- (6) Continue to open and close valve for 2 or 3 minutes. Watch for possible "freeze-up" of pump which can be detected by increase of load on the drive or by "screeching" of the pump. Stop test and overhaul pump if it "freezes."
- (7) Increase drive speed to 600 rpm and repeat (3) through (6) above.
- (8) Increase drive speed to 1,200 rpm and repeat (3) through (6) above. Continue (6) above until oil temperature is raised to 160° F.
- (9) End test and certify pump for installation in the vehicle.

Section IV. REPAIR AND REBUILD OF HYDRAULIC-PUMP GEAR DRIVE

116. Disassembly

(fig. 67)

a. REMOVE PIPE FITTINGS AND VENT.

- (1) Remove the drain plug and drain the oil from the case into a one gallon container.
- (2) Remove the pipe plug and the elbow through which oil is poured into the gear drive case.
- (3) Remove the vent.

Caution: The vent cap, containing a spring and fibre disk is clinched onto the vent fitting. If removed or otherwise

damaged, a complete new vent assembly must be installed.

Do not remove the cap from the vent fitting.

b. REMOVE CASE COVER. Remove four nuts and lock washers and remove the case cover and gasket.

c. REMOVE THE IDLER GEAR.

- (1) Remove four nuts and lock washers, and remove the idler-gear cover and gasket from the rear side of the case.

Note. The hydraulic-pump assembly is installed at the front side of the case.

- (2) Using snap-ring pliers, remove the idler-gear-shaft-bearing retaining ring from the end of the shaft.
- (3) Remove four nuts and lock washers, and remove the cover at the other end of the idler-gear shaft.
- (4) Using snap-ring pliers, remove the retaining ring that is just inside of the last cover removed.
- (5) Using a block of wood turned down to the exact diameter of the idler-gear shaft, tap the rear end of the shaft to drive the shaft toward the front end of the case and to free the shaft from the ball bearing that is at the rear end of the shaft.

Note. The two bearings which support this shaft are driving fits on the shaft while the idler gear is a push fit on the shaft and is secured to the shaft with a key. Because of the size of the idler gear, it can not be removed through either side of the gear case, but must be lifted out through the opening in the top of the case.

- (6) When the end of the shaft has been removed from the ball bearing at the rear, push the bearing out of its recess in the side of the case into the case and lift the bearing out through the opening in the top of the case.

Note. There is a shoulder on the outer side of the bearing recess which prevents the removal of the bearing through the side of the case. Both bearings are push fits in the recesses of the case.

- (7) Lift the idler-gear spacer that is at the rear of the idler gear off the shaft and remove it, either through the opening at the top of the case, or through the opening of the case.
- (8) Continue tapping the shaft out of the case until the idler gear is freed from the shaft. Lift the idler gear out through the opening at the top of the case.
- (9) Remove the idler-gear spacer that was at the front of the idler gear, and the key which secured the idler gear to the shaft.
- (10) Pull the shaft, together with the bearing which is still on the shaft, out through the front of the case.
- (11) Use an arbor press, or the block of wood ((5) above), to press or tap the shaft out of the ball bearing.

d. REMOVE THE FLANGE AND DRIVE GEAR.

- (1) Remove screw, lock washer, and plain washer and pull the flange from the end of the drive-gear shaft. The flange is a push fit on the end of the shaft. If necessary, it can be started off by gently tapping alternate sides of the flange lightly with a wooden, plastic, or rawhide mallet.
- (2) Remove four nuts and lock washers, and remove the cage assembly (at the rear of the case) and the gasket. Lift the oil seal from the milled surface at the internal side of the cage.
- (3) Remove four nuts and lock washers, and remove the drive-gear cover (at the front of the case) and gasket.
- (4) Using snap-ring pliers, remove the internal retaining ring from the front of the case.
- (5) Using a block of wood turned down to the exact diameter of the drive-gear shaft, tap the rear end of the shaft to drive the shaft forward through the case until the ball bearing which is at the rear end of the shaft is freed from the shaft.

Note. As in the case of the idler gear, the drive gear must be removed through the opening at the top of the case. Both of the ball bearings on the drive-gear shaft are driving fits on the shaft, and both are push fits in the bearing recesses of the case. The drive gear is a push fit on the shaft, and is secured to the shaft by a key.

- (6) After the shaft has been pushed out of the bearing at the rear end of the shaft, remove the bearing from the case, either through the opening at the top of the case, or through the rear of the case. Remove the drive-gear spacer that is at the rear of the drive gear.
- (7) Continue driving the shaft forward until the drive gear is freed from the shaft. Lift the drive gear out through the opening at the top of the case, and remove the spacer that was at the front of the drive gear, and the key which secured the gear to the shaft.
- (8) Lift the shaft, together with the ball bearing remaining on the shaft, out through the front of the case.
- (9) Using an arbor press or block of wood ((5) above), press or tap the shaft out of the ball bearing.

e. REMOVE DRIVEN GEAR.

- (1) Remove six nuts and lock washers and remove the driven-gear cover and gasket.
- (2) Straighten the tabs of the ball-bearing lock washer at the front end of the driven-gear shaft. Remove the ball-bearing lock nut and lock washer from the end of the shaft.

- (3) Using a block of wood turned down to the exact diameter of the driven-gear shaft, tap the front end of the shaft to drive the shaft backward through the case, to free the shaft from the ball bearing which is at the front end of the shaft.

Note. As in the case of the idler gear, the driven gear must be removed through the opening at the top of the case. The ball bearing at the front end of the shaft can be removed through the front side of the case when it has been freed from the shaft. Both of the ball bearings on the shaft are driving fits on the shaft, and are push fits in the bearing recesses of the case. The driven gear is a push fit on the shaft and is secured to the shaft with a key.

- (4) After the shaft has been driven out of the ball bearing at the front of the shaft, reach inside the case through the opening at the top, and push the bearing forward out of its recess in the case. Remove the drive-gear-shaft spacer from the shaft at the front side of the driven gear.
- (5) Continue driving the shaft backward through the case until the driven gear has been freed from the shaft. Remove this gear through the opening at the top of the case. Remove the remaining shaft, spacer, and the key that secured the gear to the shaft.
- (6) Lift the shaft and the ball bearing, which remains on the shaft, out through the rear side of the case.
- (7) Using an arbor press or wood block ((3) above), press or tap the shaft out of the ball bearing.

117. Cleaning

Wash all parts in dry-cleaning solvent or volatile mineral spirits paint thinner and remove all gasket material that may remain on the case or covers. Dry parts with filtered compressed air. Pay particular attention to the removal of all metal particles which may have accumulated inside the case. Remove all metal filings from the drain plug.

118. Inspection

a. Examine the three gears, three shafts, six bearings, and six spacers for damage or wear (par. 142). Parts must not only be within the serviceability standards, but must also be free from dents, scratches, nicks, or burrs, which would interfere with their proper functioning.

b. Examine the machined surfaces of the case for nicks or burs and examine the entire case for cracks.

c. Examine the five covers and the cage for dents or breaks which

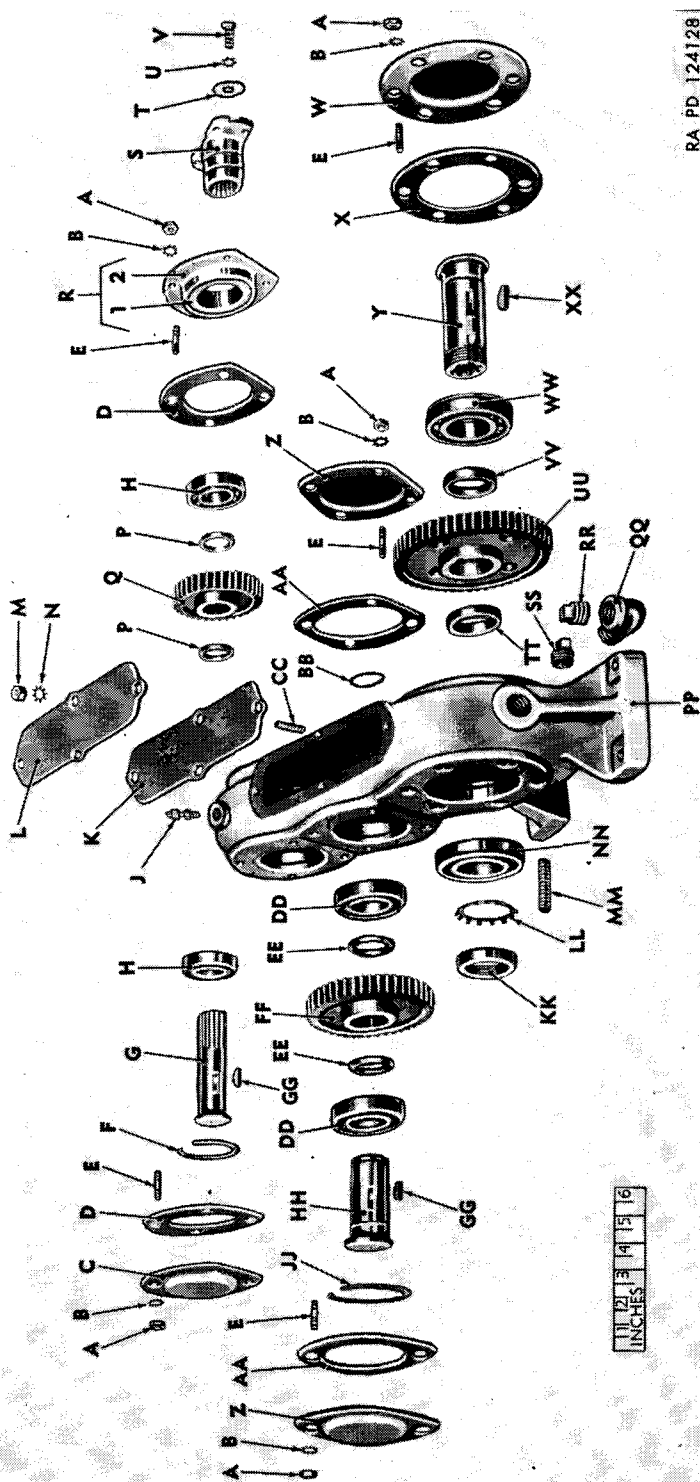


Figure 67. Hydraulic-pump gear-drive—exploded view.

A—NUT, $\frac{3}{8}$ -24NF-2—225831
 B—WASHER, LOCK, $\frac{3}{8}$ -IN—138489
 C—COVER, DRIVE-GEAR—7261531
 D—GASKET (DRIVE-GEAR-SHAFT-COVER-TO-CASE (1), SHAFT-CAGE-TO-CASE (1))—7261532
 E—STUD, $\frac{3}{8}$ -24NF-2, $\frac{3}{8}$ -16NC x $1\frac{1}{8}$
 F—RING, RETAINING, DRIVE-GEAR—7763263
 G—SHAFT, DRIVE—7261524
 H—BEARING, BALL, 1.811 BORE—700079
 J—VENT—A378931
 K—GASKET, COVER-TO-CASE—7261542
 L—COVER, CASE—7261541
 M—NUT, $\frac{5}{16}$ -24NF-2—221157
 N—WASHER, LOCK, $\frac{5}{16}$ -IN—138485
 P—SPACER, DRIVE-GEAR—7261521
 Q—GEAR, DRIVE—7261518
 R—CAGE, ASSEMBLY—7261528
 1—SEAL, OIL—500251
 2—CAGE—7261527
 S—FLANGE—7261464
 T—WASHER, PLAIN, $1\frac{13}{32}$ IN—7261597
 U—WASHER, LOCK $\frac{3}{8}$ -IN—138489
 V—SCREW, $\frac{3}{8}$ -24NF-2 x $\frac{3}{4}$ —213922
 W—COVER, DRIVEN-GEAR—7261539
 X—GASKET (DRIVEN-GEAR-COVER-TO-CASE)—7261540
 Y—SHAFT, DRIVEN—7261526
 Z—COVER, IDLER-GEAR—7261535
 AA—GASKET, IDLER-GEAR-COVER-TO-CASE—7261536
 BB—RING, RETAINING, IDLER-GEAR-SHAFT-BEARING (OPPOSITE PUMP SIDE)—7750100
 CC—STUD, $\frac{5}{16}$ -24NF-2, $\frac{5}{16}$ -18NC x $1\frac{5}{16}$ —7261516
 DD—BEARING, BALL, 1.378 BORE—700080
 EE—SPACER, IDLER-GEAR—7261522
 FF—GEAR, IDLER—7261519
 GG—KEY, $\frac{5}{16}$ x 1—117977
 HH—SHAFT, IDLER—7261525
 JJ—RING, RETAINING, IDLER-GEAR-SHAFT-BEARING (PUMP SIDE)—7750326
 KK—NUT, LOCK, BALL-BEARING (DRIVEN GEAR SHAFT)—711015
 LL—WASHER, LOCK, BALL-BEARING (DRIVEN GEAR SHAFT)—711209
 MM—STUD, $\frac{5}{16}$ -24NF-2, $\frac{5}{16}$ -18NC x $1\frac{5}{16}$ —7261515
 NN—BEARING, BALL, 1.3780 BORE—700080
 PP—CASE—7261513
 QQ—ELBOW, PIPE, 90-DEG, $\frac{1}{2}$ -IN—127961
 RR—PLUG, PIPE, $\frac{1}{2}$ -IN—143981
 SS—PLUG, DRAIN, $\frac{1}{2}$ -14NPT—7524412
 TT—SPACER, DRIVEN-GEAR—7261596
 UU—GEAR, DRIVEN—7261520
 VV—SPACER, DRIVEN-GEAR—7261523
 WW—BEARING, BALL, 1.5748 BORE—700081
 XX—KEY, $\frac{5}{16}$ x 1—117977

Figure 67—Continued

would cause them to seat improperly on their gaskets, or which might cause them to rub against internal moving parts. Examine the machined surface of the cage against which the oil seal seats, to make certain that the surface is not marked by deep scratches or burs, and examine the oil seal for wear (par. 142), scratches or burs.

d. Examine the vent by poking a small rod upward through the bottom opening of the vent fitting to determine whether or not the fibre disk inside the vent cap is free to move against the spring which holds it. If the spring is "frozen" and the valve will not move, replace the vent assembly.

e. Examine the threads of the 28 studs in the sides of the case, and the 4 studs in the top of the case to make certain that they are in good condition. Replace any studs having damaged threads.

119. Assembly

(fig. 67)

a. INSTALL DRIVEN GEAR.

Note. Check the serviceability standards to determine correct spacer and bearing for each end of the driven-gear shaft. The front side of the case is the side at which the hydraulic pump is installed.

- (1) Press a 1.5748-inch-bore ball bearing onto the driven-gear shaft, seating it against the shoulder at the rear end of the shaft.

Note. The bearing snap is to be placed at the rear side.

- (2) Install one driven-gear-shaft spacer over the end of the shaft, and press it up against the ball bearing.
- (3) Insert the front end of the shaft through the opening at the bottom-rear side of the case, place the key in the shaft key slot, and install the driven gear over the end of the shaft inside of the case. Slide the gear over the key. The gear can be lowered into the case through the top opening, and can be pushed onto the shaft by hand, or by tapping the shaft while allowing the gear to be pressed against the side of the case to keep it from moving while the shaft is being driven into it.
- (4) Install the remaining driven-gear-shaft spacer over the front end of the shaft, and push it up against the gear.
- (5) Drive the shaft as far forward in the case as possible, thus seating the ball bearing at the rear end of the shaft in its recess in the case.
- (6) Using an arbor press or wooden, plastic, or rawhide mallet, install the remaining driven-gear-shaft ball bearing over the

front end of the driven-gear shaft by driving it onto the shaft until it seats in the recess of the case without moving the shaft backward through the case.

- (7) Install the ball-bearing lock washer on the front end of the shaft. Install the ball-bearing lock nut, tightening it down against the washer. Turn the washer tabs up to secure the nut in place.
- (8) Position the driven-gear cover gasket over the six studs on the rear side of the case, install the driven-gear cover over the gasket, and secure the cover in place with six lock washers and nuts.

b. INSTALL DRIVE GEAR AND FLANGE.

- (1) Press one of the two 1.811-inch-bore ball bearings over the rear end of the drive-gear shaft, and seat the bearing against the shoulder at the front of the shaft.

Note. The two ball bearings used with the drive-gear shaft are interchangeable.

- (2) Place one of the two drive-gear spacers on the shaft, pushing it up against the ball bearing.

Note. The two spacers used on this shaft are interchangeable.

- (3) Insert the rear end of the shaft through the opening at the top on the front side of the drive-gear case. Install the key in the slot of the shaft, and install the drive gear over the end of the shaft. Slide the gear over the key. The gear can be lowered into the case through the top opening, and can be pushed onto the shaft, either by hand, or by tapping the front end of the shaft while allowing the gear to be pressed against the inside of the case to keep it from moving while shaft is driven into it.
- (4) Install the remaining drive-gear spacer on the shaft.
- (5) Drive the shaft backward through the case to seat the ball bearing at the front of the shaft all the way into the recess in the case.
- (6) Using snap-ring pliers, install the internal retaining ring in front of the ball bearing at the front side of the case.
- (7) Drive the remaining ball bearing onto the rear end of the shaft until it is seated properly in its recess in the case. The bearing can be installed by using an arbor press, or by tapping it onto the shaft with a wooden, plastic, or rawhide mallet.
- (8) Position the drive-gear-cover gasket over the four studs at the front side of the case. Install the drive-gear cover on top of the gasket and secure with four lock washers and nuts.
- (9) Position the shaft-cage-to-case gasket over the four studs at

the rear side of the case. Install the oil seal inside the bore of the cage at the front side. Install the cage assembly on top of the gasket and secure with four lock washers and nuts.

- (10) Install the flange over the rear end of the drive-gear shaft, mating the splined teeth of the two parts and seating the flange all the way down onto the shaft. Install the plain washer on the rear side of the flange at the rear end of the shaft, and secure the flange to the shaft with a lock washer and screw.

c. INSTALL THE IDLER GEAR.

- (1) Press one of the two 1.378-inch-bore ball bearings over the rear end of the idler-gear shaft and seat it against the shoulder at the front of the shaft.

Note. The two idler-gear-shaft ball bearings are interchangeable.

- (2) Install one of the two idler-gear-shaft spacers on the shaft and press it against the ball bearing.

Note. The two idler-gear-shaft spacers are interchangeable.

- (3) Insert the rear end of the shaft through the center opening at the front side of the case. Install the key in the shaft slot and install the idler gear inside of the case over the end of the shaft. Slide the gear over the key. The gear can be lowered into the case through the top opening, and can be pushed onto the shaft, either by hand, or by tapping the front end of the shaft while allowing the gear to be pressed against the inside of the case to keep it stationary while the shaft is driven into it.
- (4) Drive the shaft backward through the case until the ball bearing at the front end is seated in its recess in the case.
- (5) Using snap-ring pliers, install the retaining ring in front of the ball bearing at the front side of the case.
- (6) Install the remaining idler-gear-shaft spacer over the rear end of the shaft and push it up against the idler gear.
- (7) Install the remaining ball bearing over the rear end of the shaft, without moving the shaft, seating it in its recess in the case. This bearing can be pressed onto the shaft with an arbor press, or can be tapped on with a wooden, plastic, or rawhide mallet.
- (8) Using snap-ring pliers, install the idler-shaft-bearing retaining ring at the rear end of the shaft.
- (9) Place one of the two idler-gear-cover-to-case gaskets over the four studs at the rear side of the case. Install one of the two idler-gear covers and secure with four lock washers and nuts.

- (10) In like manner, install the remaining gasket and cover at the front side of the case.

d. INSTALL THE COVER, VENT, AND PIPE FITTINGS.

- (1) Place the cover-to-case gasket over the four studs at the top of the case. Install the cover and secure with four lock washers and nuts.
- (2) Install the vent in the threaded bore at the top of the case.
- (3) Install the drain plug in the threaded bore at the bottom of the case.
- (4) Install the elbow in the threaded bore at one end of the case and tighten it so that it will point straight up. Install the pipe plug in the elbow.

Section V. REPAIR AND REBUILD OF HYDRAULIC-PUMP PROPELLER SHAFT

120. General

(fig. 57)

The propeller shaft is necessarily disassembled during removal of the shaft from the vehicle (par. 94), with the exception of the two journals used in the assembly. These are not to be disassembled as they are obtainable only as complete assemblies.

121. Cleaning

Clean all parts thoroughly in dry-cleaning solvent or volatile mineral spirits paint thinner and dry with filtered compressed air.

122. Inspection

Whenever the assembly is removed from the vehicle, check the various parts against the serviceability standards to determine whether the original parts are to be used for installation, or whether new parts must be used (par. 143).

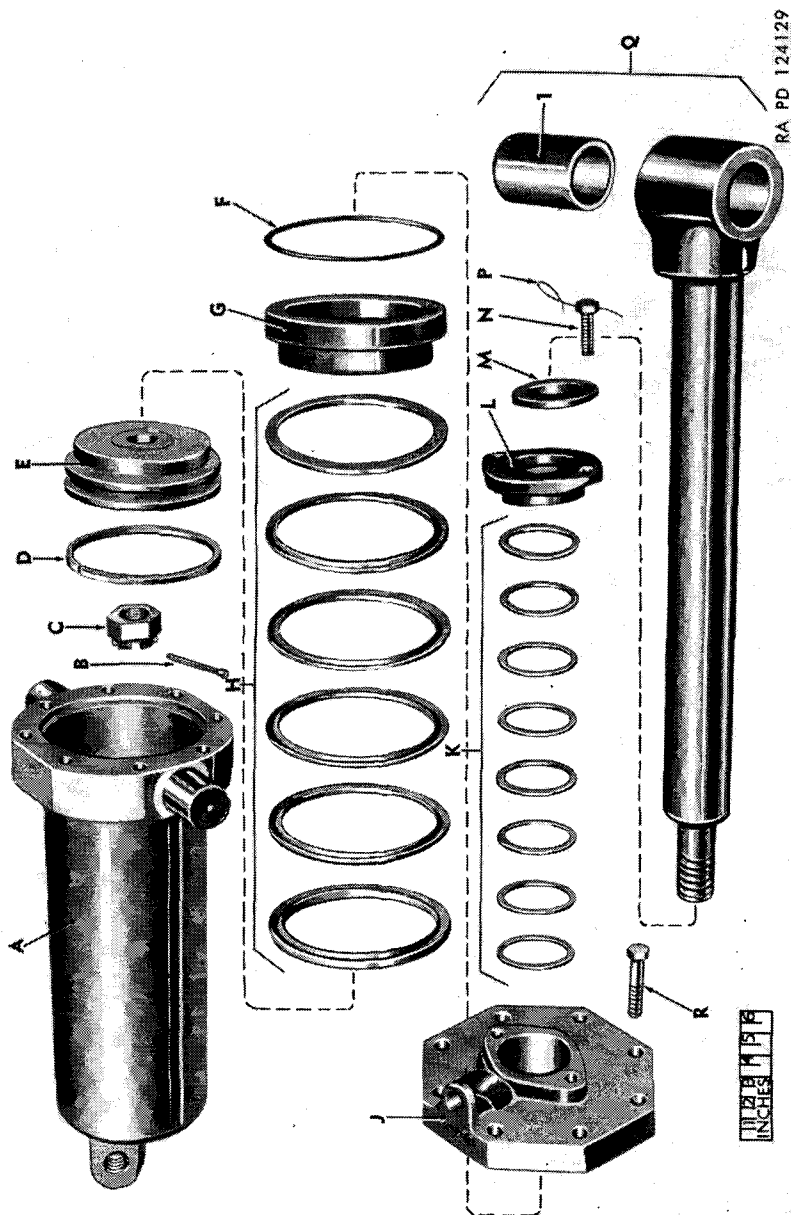
Section VI. REPAIR AND REBUILD OF HYDRAULIC CYLINDER

123. Disassembly

(fig. 68)

a. REMOVE RAM.

- (1) Remove eight bolts and slide the cover along the ram away from the cylinder.
- (2) Pull the ram out of the cylinder with the piston attached and the cover still on the rod.



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Figure 68. Hydraulic cylinder and ram—exploded view.

A—CYLINDER, HYDRAULIC: LEFT—7261636; RIGHT—7261637
 B—PIN, COTTER, $\frac{1}{4}$ x 3—137318
 C—NUT, $1\frac{1}{2}$ -12NF-2—571232
 D—RING, BEARING, UPPER-PISTON—7261644
 E—PISTON, UPPER—7261646
 F—GASKET, PACKING (CYLINDER COVER)—546839
 G—PISTON, LOWER—7261645
 H—PACKING SET, PISTON—7261470
 J—COVER—7261641
 K—PACKING SET, RAM—7705560
 L—GLAND, RAM, PACKING—7261585
 M—SEAL, OIL, RAM—7705568
 N—SCREW, $\frac{1}{2}$ -20NF-2 x $1\frac{1}{2}$ —426964
 P—WIRE, LOCKING—22-W-1642-125
 Q—RAM, PISTON, W/BEARING—7323550
 1—BEARING, BUSHING-TYPE—7323548
 R—BOLT, $\frac{5}{8}$ -18NF-2 x 3—223815

Figure 68.—Continued

b. REMOVE PISTON.

- (1) Remove the cotter pin and the nut from the end of the piston ram.
- (2) Remove the upper piston, six piston packings, and the lower piston from the ram. The upper-piston-bearing ring will remain with the upper piston. Remove the ring from the upper piston.
- (3) Slide the cover, together with the cylinder-cover packing gasket, off the piston ram. The gasket is seated in the groove at the end of the hydraulic cylinder and may or may not be loose on the ram following removal of the cover. If it remains in the cylinder, lift it out.

c. REMOVE RAM PACKING GLAND AND PACKING SET.

- (1) Cut the locking wire and remove the two screws which secure the gland to the cover.
- (2) Remove the gland from the cover.
- (3) Drive the oil seal out of the gland by tapping around the inner side of the seal.
- (4) Remove the ram packing set from inside the bore of the cover.

124. Cleaning

Clean all metal parts thoroughly with dry-cleaning solvent or volatile mineral spirits paint thinner and dry them with filtered compressed air.

125. Inspection

a. Inspect the bearing surfaces of the two pistons, the bore of the hydraulic cylinder, the bore of the cover, and the surface of the piston ram for nicks and scratches.

b. Inspect the piston and ram packing set for damage and for brittleness due to impregnation with dried oil and/or dirt.

c. Inspect the bearing surfaces of the stub shafts of the cylinder for nicks and scratches.

d. Inspect the bushing-type bearing installed in the piston-ram eye for out-of-roundness of its internal diameter and for nicks and scratches.

e. Inspect the ram oil seal for out-of-roundness of its internal diameter and for nicks and scratches.

126. Repair and Rebuild

a. Polish out all rough spots of bearing surfaces having nicks or scratches, using a dry, medium aluminum-oxide abrasive cloth. Replace any parts which are badly worn, or which have scratches that are too deep to be removed.

b. If the bushing-type bearing in the ram eye is deeply scratched or out-of-round, press the bearing out of the eye, using an arbor press, and install a new bearing.

c. If the piston, ram, oil seal, gasket, or any of the packings are damaged, worn, or brittle, replace with new parts.

127. Assembly

(fig. 68)

a. INSTALL RAM-PACKING GLAND ON COVER.

- (1) Install the ram oil seal in the recess at the external side of the ram-packing gland, tapping it well down against the shoulder of the recess.
- (2) Place the ram-packing gland with the ram oil seal on the side toward the ram eye over the ram. Push the gland well up onto the ram.
- (3) Install the ram packing set in the bore of the cover, inserting it from the outer side of the cover.
- (4) Place the cover over the end of the ram with the outer side of the cover facing the packing gland. Push the cover against the packing gland already installed on the ram.
- (5) Install the two screws to hold packing gland to cover without securing.

b. INSTALL THE PISTON ON THE RAM.

- (1) Install the lower piston with the side of the piston having the deep recess facing the ram eye on the ram. Push the piston back against the shoulder at the end of the ram.
- (5) Install three piston packings over the end of the lower piston.
- (3) Install the upper-piston-bearing ring over the upper piston, pushing it back against the flange at the large end of the piston. Install the three remaining piston packings over the smaller diameter of the upper piston.
- (4) Install the upper piston over the end of the ram, with the small diameter side pushed tightly against the lower piston.
- (5) Secure the pistons to the ram by installing the nut and a new cotter pin.

c. INSTALL RAM AND PISTON IN CYLINDER.

- (1) Place a new cylinder-cover packing gasket in the groove at the end of the hydraulic-cylinder bore.
- (2) Insert the piston into the cylinder bore, and push it down into the cylinder until the cover, already installed on the ram, is up against the end of the cylinder.
- (3) Secure the cover to the cylinder with eight bolts.
- (4) Tighten the two screws which secure the ram-packing gland to the cover, and install locking wire.

Section VII. REPAIR AND REBUILD OF EMERGENCY-LIFT HAND-OPERATED PUMP

128. Disassembly

(fig. 71)

a. REMOVE PUMP OPERATING LEVER AND INLET PIPE.

- (1) Remove the inlet pipe from the bottom of the pump housing.
- (2) Remove the cotter pin and the pin which secures the pump operating lever to the plunger operating lever, and remove the pump operating lever.
- (3) Remove the knurled knob from the pump operating lever.

b. REMOVE PLUNGER OPERATING LEVER.

- (1) Remove the two screws and the plunger-operating-lever packing retainer.
- (2) Lift out the packing filler ring, and the plunger-operating-lever packing.
- (3) Remove the two pipe plugs that enclose the ends of the plunger-operating lever pin.
- (4) Drive out the pin with a pin punch (fig. 69).
- (5) Lift the plunger-operating lever out of the housing.

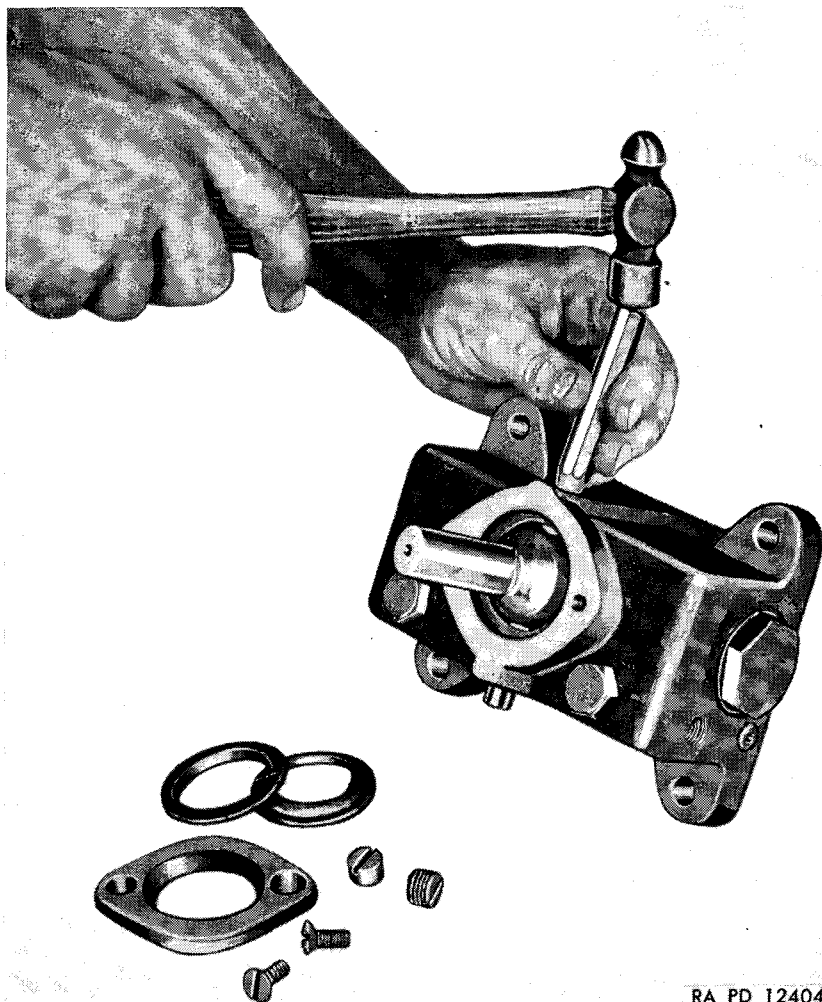


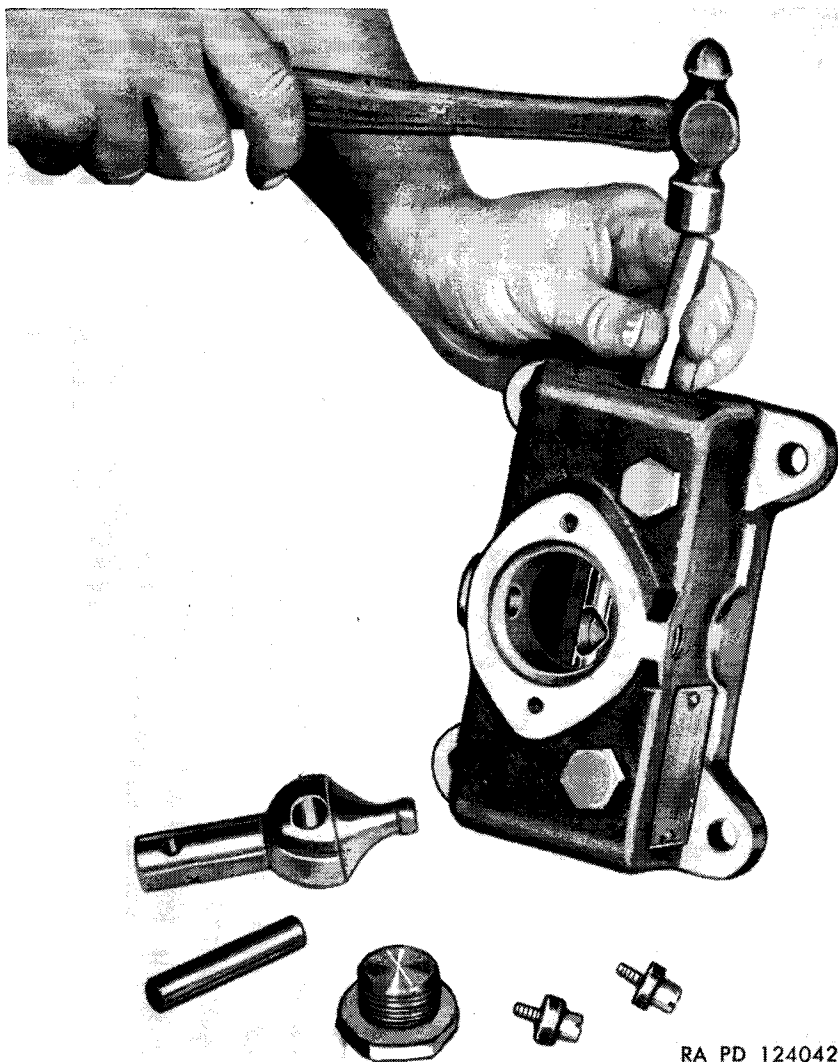
Figure 69. Removing plunger-operating-lever pin.

c. REMOVE PLUNGER.

- (1) Remove the plunger cap and gasket from the pump housing.
- (2) Remove one plunger retaining screw from each end of the plunger together with the oil seals.
- (3) Drive the plunger out of the bore in the housing with a pin punch (fig. 70).

d. REMOVE VALVES.

- (1) Remove the two check-valve-spring retainers.
- (2) Invert the housing and drop out the two outer check-valve springs, and two outer check-valve balls, the two inner check-valve springs, and the two inner check-valve balls.



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Figure 70. Removing pump plunger.

- (3) Remove the screw that secures the release-valve operating lever and remove lever.
- (4) Remove the release valve and the release-valve-packing nut.
- (5) Pry out the two release-valve packings.

129. Cleaning

Clean all parts thoroughly with dry-cleaning solvent or volatile mineral spirits paint thinner and dry them with filtered compressed air.

130. Inspection

Check to see that parts are within the limits of the repair and rebuild standards (par. 144), replace as necessary. Inspect the housing carefully for obvious damage, and particularly inspect the plunger, bore, the seats of the release valve and the four check valves, and the valves for scratches.

131. Repair and Rebuild

Reground the valve seats, if necessary, using a fine valve-grinding compound.

132. Assembly

(fig. 71)

a. INSTALL PLUNGER.

- (1) Insert the plunger into the plunger bore of the pump housing, positioning it so that the detent for the plunger operating lever is up and approximately centered in the plunger-operating-lever bore.
- (2) Install a new plunger oil seal at each end of the plunger and secure with the retaining screws.
- (3) Install a new plunger gasket and the plunger cap at the end of the pump housing that is to be the rear end (the release-valve lever will be on the right side).

b. INSTALL PLUNGER OPERATING LEVER.

- (1) Insert the plunger operating lever into its bore in the pump housing with the small rounded end engaged in the detent of the plunger.
- (2) Position the lever with the plunger-operating-lever-pin bore in the lever crosswise in the housing to align it with the pin bores in the housing.
- (3) Insert the plunger-operating-lever pin so that it engages the lever and holds it in the housing.
- (4) Install the $\frac{1}{4}$ -inch plunger-operating-lever-pin pipe plugs at each end of this pin.
- (5) Place a new plunger-operating-lever packing over the lever and push it down around the ball portion of the lever inside the housing.
- (6) Place a new packing filler ring on top of the packing.
- (7) Position the plunger-operating-lever-packing retainer on top of the housing and install two $\frac{1}{4} \times \frac{5}{8}$ -inch screws to secure the retainer.

c. INSTALL VALVES.

- (1) Into each of the two bores at the top of the housing (one on

each side of the plunger-operating lever) drop a $\frac{1}{4}$ -inch check-valve ball, a small check-valve spring, a $\frac{3}{8}$ -inch check-valve ball, and a $\frac{5}{16}$ -inch check-valve spring.

- (2) Install the two check-valve-spring retainers.
- (3) Insert two new release-valve packings into the release-valve bore in the housing.
- (4) Install the release-valve-packing nut and turn it down tight against the packing.
- (5) Install the release valve and turn it down until it seats.
- (6) Position the release-valve operating lever on the end of the valve so that it projects upward and secure it with a $\frac{1}{4} \times \frac{3}{8}$ -inch screw.

d. **INSTALL INLET PIPE AND PUMP OPERATING LEVER.**

- (1) Screw the inlet pipe into its bore in the bottom of the pump housing.
- (2) Place the sleeve at the bottom of the pump operating lever over the top of the plunger operating lever and secure it in place with the pin and cotter pin (figs. 46 and 53).
- (3) Install the knurled knob on the operating lever.

133. Test and Adjustments

a. **PREPARATION FOR TEST.**

- (1) Install the pump on the hand-operated pump oil reservoir (par. 84).
- (2) Fill the reservoir with hydraulic oil (fig. 47), but do not install the oil-filler plug.
- (3) Prepare a second pump in the same manner.
- (4) Connect the outlet ports of the two pumps together with a hand-operated-pump-to-hydraulic-jack rubber hose.

b. **TESTING OPERATION OF BOTH PUMPS.**

- (1) Open the release valves of both pumps.
- (2) Operate the pump operating lever of the first pump. The oil level in the oil reservoir of the second pump should steadily rise.
- (3) Operate the pump operating lever of the second pump. The oil level in the oil reservoir of the first pump should steadily rise.
- (4) Close the release valve of the second pump and operate the pump operating lever of the first pump. After a limited number of strokes (15 to 25, depending upon length of stroke taken) it should become impossible to continue operating the lever. There should be no rise of the oil level in the oil reservoir of the second pump.
- (5) Open the release valve of the second pump and close the re-

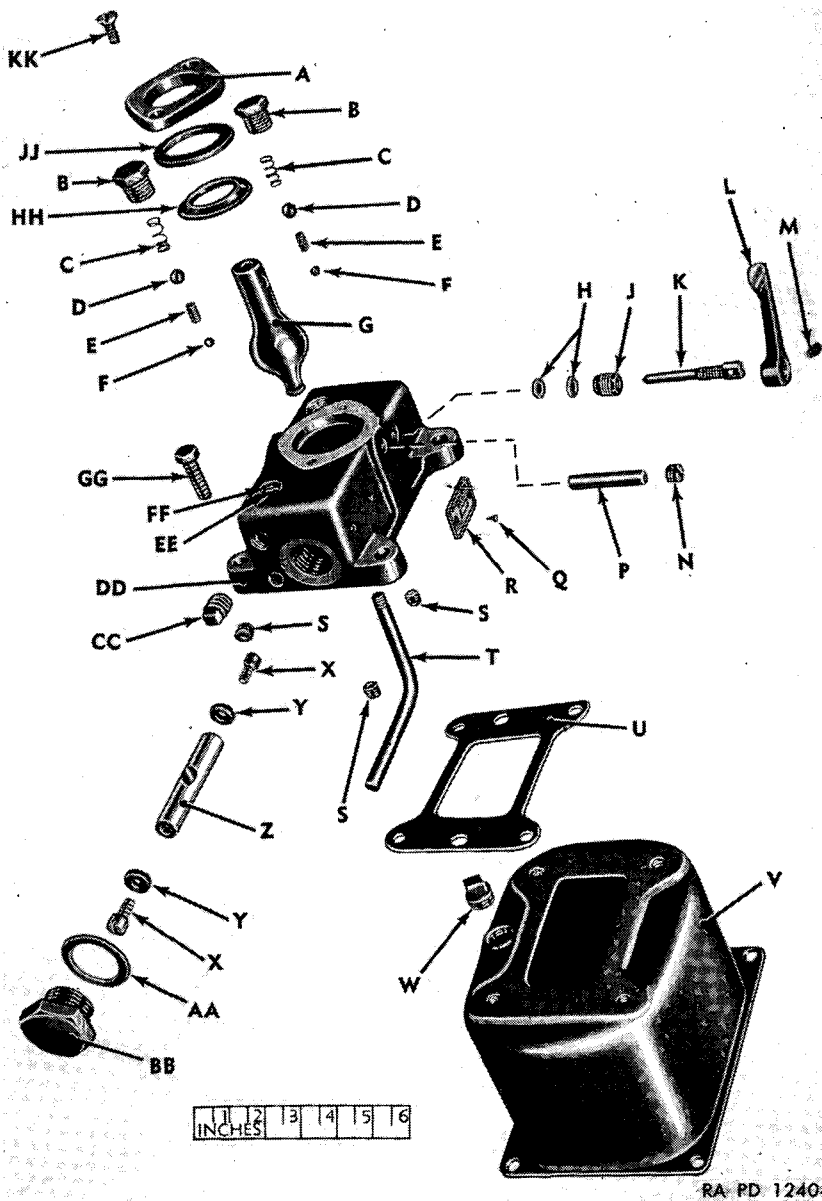


Figure 71. Emergency-lift hand-operated pump and reservoir—exploded view.

- A—RETAINER, PACKING, PLUNGER-OPERATING-LEVER—7097402
 B—RETAINER, SPRING, CHECK-VALVE—7520845
 C—SPRING, COMPRESSION, $\frac{5}{16}$ -IN (CHECK-VALVE)—7097391
 D—BALL, CHECK-VALVE, $\frac{3}{8}$ -IN—145633
 E—SPRING, COMPRESSION (CHECK-VALVE)—7097393
 F—BALL, CHECK-VALVE, $\frac{1}{4}$ -IN—145629

G—LEVER, OPERATING, PLUNGER—7089404
 H—PACKING, RELEASE-VALVE—7520844
 J—NUT, PACKING, RELEASE-VALVE—7347506
 K—VALVE, RELEASE—7520847
 L—LEVER, OPERATING, RELEASE-VALVE—7089473
 M—SCREW, $\frac{1}{4}$ -20NC-3 x $\frac{3}{8}$ —191956
 N—PLUG, PIPE, $\frac{1}{4}$ -IN (PLUNGER-OPERATING-LEVER-PIN)—103884
 P—PIN, PLUNGER-OPERATING-LEVER—7097394
 Q—SCREW, NO. 4-40 x $\frac{1}{4}$ —CSS-X88-1
 R—PLATE, NAME—CSS-A2078-6
 S—PLUG, PIPE, $\frac{1}{8}$ -IN (INLET)—189566
 T—PIPE, INLET—7520849
 U—GASKET, PUMP-TO-RESERVOIR—7520846
 V—RESERVOIR, OIL—7520848
 W—PLUG, FILLER, RESERVOIR, $\frac{1}{2}$ -IN—7520869
 X—SCREW, RETAINING, PLUNGER, OIL-SEAL—7097397
 Y—SEAL, OIL, PLUNGER—7089405
 Z—PLUNGER—7089422
 AA—GASKET, PLUNGER-CAP—7097392
 BB—CAP, PLUNGER—7097395
 CC—PLUG, PIPE, $\frac{1}{4}$ -IN (OUTLET)—CSS-X1-11
 DD—HOUSING, HAND-OPERATED-PUMP—CSS-N1005-.562
 EE—SEAT, INLET-CHECK-VALVE—7089418
 FF—SEAT, OUTLET-CHECK-VALVE—7089419
 GG—SCREW, $\frac{3}{8}$ x $1\frac{1}{4}$ -IN—CSS-X2-9
 HH—PACKING, PLUNGER-OPERATING-LEVER—7097398
 JJ—RING, FILLER, PACKING—7089406
 KK—SCREW, $\frac{1}{4}$ -20NC-2 x $\frac{5}{8}$ —120655

Figure 71—Continued

lease valve of the first pump. Operate the pump operating lever of the second pump. The result should be the same as in (4) above.

- (6) End the test and certify both pumps for installation in a vehicle.

Section VIII. REPAIR AND REBUILD OF EMERGENCY-LIFT HYDRAULIC JACK

134. Disassembly

(fig. 72)

Note. Under ordinary circumstances, it is preferable to replace the jack, rather than attempt disassembly and replacement of parts. The plug at the top of the cylinder is welded onto the cylinder while the sheave support at the end of the plunger is welded onto the plunger. Should it be necessary to make repairs (such as replacing the packing), disassembly can be effected.

a. REMOVE THE PACKING.

- (1) Cut the sheave support away from the end of the plunger.
- (2) Grind the end of the plunger to a smooth cylindrical contour.

- (3) Screw the packing nut out of the cylinder and remove it over the end of the plunger.
 - (4) Remove the plunger packing.
 - (5) Remove the wiper ring from inside the outer end of the packing nut.
- b. REMOVE PLUNGER.**
- (1) Place the cylinder in a metal lathe, carefully centering it on the lathe centers.
 - (2) Turn down the weld between the cylinder plug and the cylinder.
- Note.* This weld is approximately $\frac{1}{4}$ -inch deep. Remove the weld only until plug is free so that the plug can be used again.
- (3) Pull the plunger (with integral piston) out through the plug end of the cylinder.

135. Cleaning

Wipe off all parts thoroughly with dry-cleaning solvent or volatile mineral spirits paint thinner and dry them with filtered compressed air.

136. Inspection

If the jack is leaking (such a leak will occur around the plunger), pull the plunger out of the jack as far as possible and examine the plunger surface for nicks and scratches.

137. Repair and Rebuild

If leakage is caused by shallow scratches on the surface of the plunger, repair can sometimes be effected by resurfacing the plunger, using a strip of dry, medium aluminum-oxide abrasive cloth to polish the surface. Leaks can also be corrected by tightening the packing nut until the nut seats firmly against the end of the cylinder (when shipped from the factory, there is a $\frac{1}{16}$ - to $\frac{3}{32}$ -inch gap left between the nut and the end of the cylinder for purposes of adjustment).

138. Assembly

(fig. 72)

a. INSTALL PLUNGER.

- (1) Insert plunger (piston end last) into the cylinder-plug end of the cylinder and pull it through so that the plunger projects out the other end of the cylinder.
- (2) Place the cylinder plug in the end of the cylinder, positioning it so that the center line of the bore through the plug

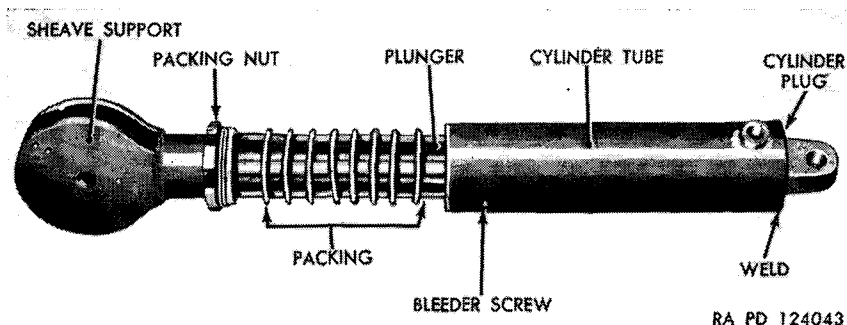


Figure 72. Emergency-lift hydraulic jack—exploded view.

top is approximately parallel to the center line of the threaded bore in the cylinder at this end.

- (3) Weld the plug to the cylinder with a $\frac{1}{4}$ -inch weld all around.

b. INSTALL SHEAVE SUPPORT.

- (1) Install eight new packing rings over the plunger and push them down into the end of the cylinder.
- (2) Install a new wiper ring inside the groove at the outer end of the packing nut.
- (3) Install the packing nut over the plunger and screw it down into the cylinder until there is only a $\frac{1}{16}$ - to $\frac{3}{32}$ -inch gap between the nut and the cylinder end.
- (4) Hold the sheave support against the end of the plunger so that the center line of the bore through the support will intersect the center line of the plunger at right angles.
- (5) Secure the support to the plunger with a $\frac{1}{4}$ -inch weld all around.

Note. Do not allow weld to build up inside the support to an extent which would interfere with rotation of the sheave mounted in the support.

Section IX. REPAIR AND REBUILD STANDARDS

139. General

a. The repair and rebuild standards included herein give the maximum and minimum dimensions of new or rebuilt parts. Wear limits are not given as these have not been adequately established for the equipment. Reasonable judgment should be used in considering the actual clearance between mating parts, before determining the serviceability or nonserviceability of any part. Parts which are uniformly worn to slightly less than minimum new dimensions can often be used successfully with mating parts which are slightly over minimum new dimensions.

b. When fitting mating parts, selection of parts must be resorted to in order to obtain desired clearances or interferences. The desired amount of clearance or interference between two parts is given here in terms of fits. If, for instance, a "push" fit is required, one or both parts must be selected to obtain the allowable clearance for this class of fit.

c. The four classes of fits referred to herein, and allowable clearance or interference for each, are as follows:

- (1) *Running fit.* The fit between two parts which must rotate or reciprocate without hindrance. Male part should be smaller than female part by 0.001 inch plus 0.001 inch for each inch of diameter.
- (2) *Push fit.* The fit between two parts which are not quite free to rotate or reciprocate, but which can be assembled by hand. Male part should be 0.001 inch to 0.0001 inch smaller than female part.
- (3) *Driving fit.* The fit between two parts which must be assembled by hammering or in a small arbor press. Male part should be same size as female part, or larger than female part by 0.001 inch for each inch of diameter.
- (4) *Forced fit.* The fit between two parts which must be assembled in a hydraulic press. Male part should be larger than female part by 0.002 inch for each inch of diameter.

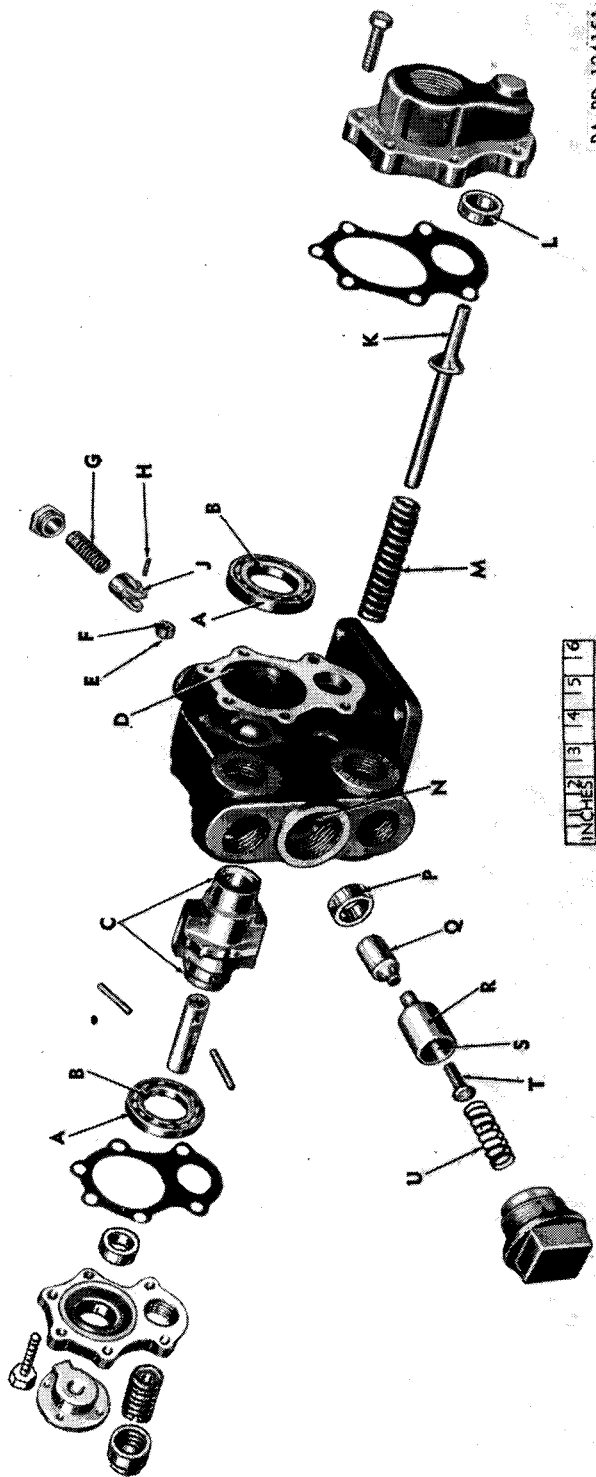
140. Hydraulic-Pump Control Valve

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts
73.....	A.....	OD of two ball bearings.....	2.6245 to 2.6250 in.
73.....	B.....	ID of two ball bearings.....	1.4995 to 1.5000 in.
73.....	C.....	OD of two ball-bearing journals on rotor.	1.4999 to 1.5004 in.
73.....	B-C....	Interference between bearing and rotor.	0.0000 to 0.0015 in.
73.....	D.....	ID of two ball-bearing recesses in body.	2.6247 to 2.6252 in.
73.....	A-D....	Clearance between bearing and body recess.	0.0010 to 0.0001 in.
73.....	E.....	OD of cam roller.....	0.624 to 0.625 in.
73.....	F.....	ID of cam roller.....	0.2515 to 0.2520 in.
73.....	H.....	OD of cam-roller pin.....	0.2485 to 0.2490 in.
73.....	F-H....	Clearance between cam roller and pin.	0.0025 to 0.0035 in.
73.....	J.....	ID of cam-roller-pin bores in cam-roller plunger.	0.2490 to 0.2495 in.
73.....	H-J....	Clearance between cam-roller pin and plunger.	0.0010 to 0.0001 in.
73.....	G.....	Free length of cam-roller spring (aprx.).	2.0625 in.

<i>Figure No.</i>	<i>Reference letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
73-----	K-----	OD of relief-valve shaft-----	0.3730 to 0.3750 in.
73-----	L-----	ID of relief-valve seat-----	0.3790 to 0.3810 in.
73-----	K-L----	Clearance between relief-valve shaft and seat,	0.0040 to 0.0080 in.
73-----	M-----	Free length of relief-valve spring (aprx.)	4.0000 in.
73-----	P-----	ID of outer-check-valve seat-----	1.1250 to 1.1270 in.
73-----	N-----	ID of check-valve-pusher bore in body.	0.7500 to 0.7510 in.
73-----	Q-----	OD of check-valve pusher-----	0.7470 to 0.7490 in.
73-----	N-Q----	Clearance between check-valve pusher and body.	0.0010 to 0.0040 in.
73-----	R-----	OD of outer check valve (measured at larger-diameter area).	1.1210 to 1.1230 in.
73-----	N-R----	Clearance between outer check valve and seat.	0.0020 to 0.0060 in.
73-----	S-----	ID of inner-check-valve bore in outer check valve.	0.3120 to 0.3130 in.
73-----	T-----	OD of inner-check-valve stem----	0.3090 to 0.3110 in.
73-----	S-T----	Clearance between inner-check-valve stem and outer check valve.	0.0010 to 0.0040 in.
73-----	U-----	Free length of check-valve-pusher spring (aprx.)	2.000 in.

141. Hydraulic Pump

74-----	A-----	OD of two gears-----	3. 3900 to 3. 3910 in.
74-----	B-----	Pitch diameter of two gears-----	2. 9990 to 3. 0010 in.
74-----	C-----	Width of two gears-----	2. 5000 to 2. 5010 in.
74-----	D-----	ID of bores in two gears-----	1. 4985 to 1. 4990 in.
74-----	E-----	OD of driven shaft and of gear-and-bearing-journal area of drive shaft.	1. 4980 to 1. 4985 in.
74-----	D-E----	Clearance between gear and shaft.	0. 0010 to 0. 0001 in.
74-----	F-----	Free length of oil-seal spring (aprx.)	1. 1875 in.
74-----	F-----	Length of oil-seal spring under 20-24 lb load.	0. 6250 in.
74-----	G-----	Thickness of two wear plates-----	0. 2710 to 0. 2810 in.
<i>Note.</i> Two faces of each wear plate must be parallel to within 0.0010 inch.			
74-----	H-----	ID of all four bearings-----	1. 5005 to 1. 5010 in.
74-----	E-H----	Clearance between bearing and shaft.	0. 0020 to 0. 0025 in.
74-----	J-----	OD of four check-valve plungers--	0. 6180 to 0. 6230 in.
74-----	K-----	ID of oil-seal retainer-----	1. 1320 to 1. 1420 in.
74-----	L-----	Thickness of oil-seal retaining ring.	0. 0625 in.
74-----	M-----	Run-out of two shafts-----	0.0010 in.
74-----	N-----	Width of drive-shaft spline-----	0.2410 to 0.2440 in.
74-----	P-----	OD of oil-seal-retainer journal on drive shaft.	1.2400 to 1.2500 in.
74-----	K-P----	Clearance between oil-seal retainer and shaft.	0.0080 to 0.0170 in.



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Figure 73. Repair and rebuild standards reference points—hydraulic-pump control valve.

<i>Figure No.</i>	<i>Reference letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
74-----	Q-----	ID of all four bearing recesses (two in each cover).	2.1870 to 2.1875 in.
74-----	R-----	OD of all four bearings-----	2.1875 to 2.1880 in.
74-----	Q-R-----	Interference between bearing and cover.	0.0000 to 0.0020 in.
74-----	S-----	ID of four check-valve-plunger bores (two in each cover).	0.6250 to 0.6350 in.
74-----	J-S-----	Clearance between check-valve plunger and cover.	0.0070 to 0.0120 in.

142. Hydraulic-Pump Gear Drive

75-----	A-----	OD of drive-gear-shaft-flange-end-bearing journal.	1.1811 to 1.1814 in.
75-----	B-----	OD of drive-gear-shaft-gear journal and opposite-flange-end-bearing journal.	1.1804 to 1.1807 in.
75-----	C-----	Major diam of drive-gear-shaft spline.	1.1715 to 1.1740 in.
75-----	D-----	Minor diam of drive-gear-shaft spline.	1.0525 to 1.0625 in.
75-----	E-----	ID of two drive-gear-shaft ball-bearings.	1.1807 to 1.1811 in.
75-----	E-B-----	Clearance between drive-gear shaft and bearing at opposite flange end of shaft.	0.0000 to 0.0007 in.
75-----	A-E-----	Interference between drive-gear shaft and bearing at flange end of shaft.	0.0000 to 0.0004 in.
75-----	F-----	OD of two drive-gear-shaft ball bearings.	2.4404 to 2.4409 in.
75-----	G-----	ID of two drive-gear-shaft-ball-bearing recesses in case.	2.4407 to 2.4413 in.
75-----	G-F-----	Clearance between drive-gear-shaft ball bearings and case.	0.0000 to 0.0009 in.
75-----	H-----	Thickness of two drive-gear-shaft spacers.	0.2480 to 0.2500 in.
75-----	J-----	ID of drive gear-----	1.1808 to 1.1814 in.
75-----	J-B-----	Clearance between drive gear and shaft.	0.0001 to 0.0010 in.
75-----	K-----	OD of drive gear-----	3.7600 in.
75-----	L-----	Pitch diam of drive gear-----	3.6000 in.
75-----	M-----	ID of cage oil seal-----	1.6875 in.
75-----	N-----	OD of flange shaft-----	1.5740 to 1.5744 in.
75-----	M-N-----	Clearance between oil seal and flange shaft.	0.1131 to 0.1135 in.
75-----	P-----	ID of idler-gear-shaft-ball-bearing recesses in case.	2.8344 to 2.8350 in.
75-----	Q-----	OD of two idler-gear-shaft ball bearings.	2.8341 to 2.8346 in.
75-----	P-Q-----	Clearance between idler-gear-shaft ball bearings and case.	0.0003 to 0.0009 in.

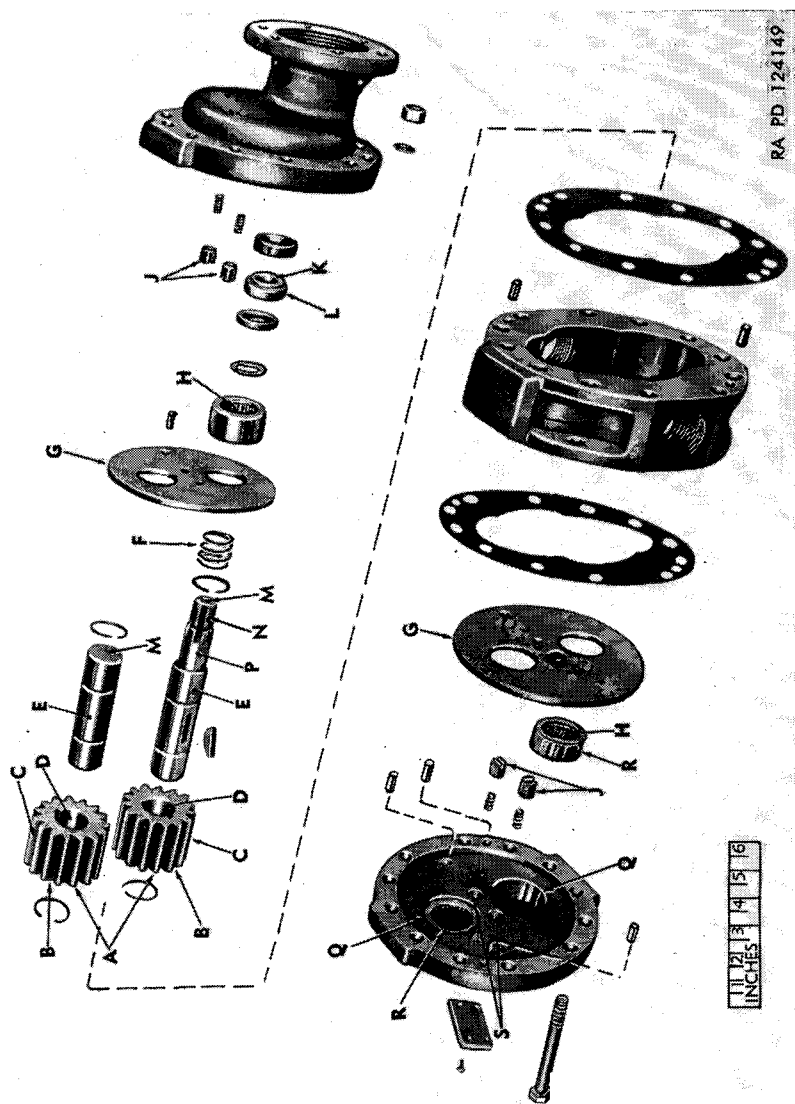
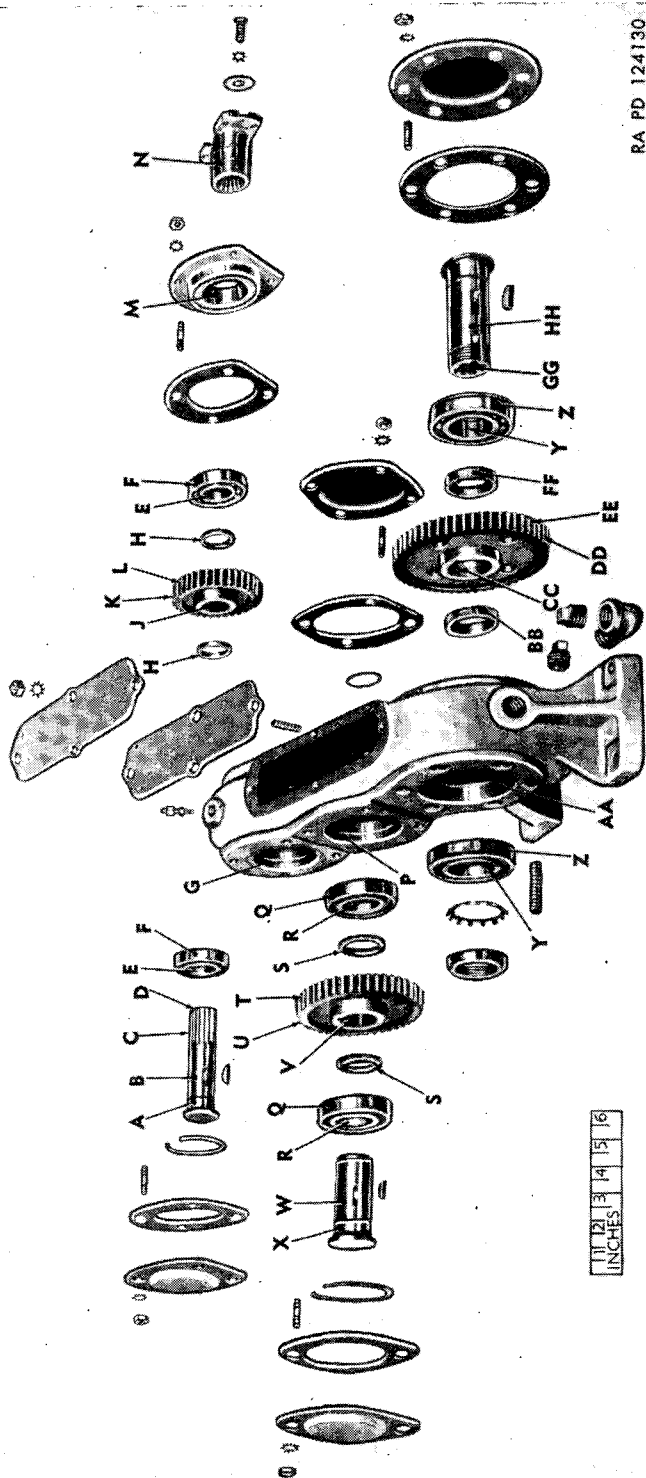


Figure 74. Repair and rebuild standards reference points—hydraulic pump.

<i>Figure No.</i>	<i>Reference letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
75-----	R-----	ID of two idler-gear-shaft ball bearings.	1.3775 to 1.3780 in.
75-----	S-----	Thickness of two idler-gear-shaft spacers.	0.2400 to 0.2480 in.
75-----	T-----	OD of idler gear-----	4.7550 to 4.7600 in.
75-----	U-----	Pitch diam of idler gear-----	4.6000 in.
75-----	V-----	ID of idler gear-----	1.3777 to 1.3787 in.
75-----	W-----	OD of idler-gear-shaft gear journal	1.3772 to 1.3776 in.
75-----	R-W----	Clearance between idler-gear shaft and ball bearing at opposite flange end of shaft.	0.0000 to 0.0001 in.
75-----	V-W----	Clearance between idler gear and shaft.	0.0005 to 0.0015 in.
75-----	X-----	OD of idler-gear-shaft flange end bearing journal.	1.3779 to 1.3783 in.
75-----	X-R----	Interference between idler-gear shaft and ball bearing at flange end of shaft.	0.0000 to 0.0008 in.
75-----	Y-----	ID of two driven-gear-shaft ball bearings.	1.5743 to 1.5748 in.
75-----	Z-----	OD of two driven-gear-shaft ball bearings.	3.1491 to 3.1496 in.
75-----	AA-----	ID of two driven-gear-shaft ball-bearing recesses in case.	3.1494 to 3.1500 in.
75-----	AA-Z---	Clearance between driven-gear-shaft ball bearing and case.	0.0003 to 0.0009 in.
75-----	BB-----	Thickness of driven-gear-shaft spacer at pump side.	0.4120 to 0.4140 in.
75-----	CC-----	ID of driven gear-----	1.5745 to 1.5755 in.
75-----	DD-----	OD of driven gear-----	5.7550 to 5.7600 in.
75-----	EE-----	Pitch diam of driven gear-----	5.6000 in.
75-----	FF-----	Thickness of driven-gear-shaft spacer opposite pump side.	0.4160 to 0.4180 in.
75-----	GG-----	Minor diam of driven-gear-shaft spline.	0.8470 to 0.8490 in.
75-----	HH-----	OD of driven-gear shaft-----	1.5740 to 1.5744 in.
75-----	Y-HH---	Clearance between driven-gear-shaft ball bearings and shaft.	0.0003 to 0.0008 in.

143. Hydraulic-Pump Propeller Shaft

76-----	A-----	Run-out of propeller shaft-----	0.0300 in.
76-----	B-----	Major diam of propeller-shaft spline.	1.1858 to 1.1863 in.
76-----	C-----	Major diam of yoke spline-----	1.1865 to 1.1875 in.
76-----	C-B----	Clearance between propeller-shaft spline and yoke spline.	0.0007 to 0.0017 in.
76-----	D-----	OD of power-take-off-coupling-flange shoulder.	2.998 to 3.002 in.
76-----	E-----	ID of oil seal-----	2.999 to 3.003 in.
76-----	E-D----	Clearance between oil seal and power take-off-coupling-flange shoulder.	0.001 to 0.005 in.



RA PD 124130

Figure 75. Repair and rebuild standards reference points—hydraulic-pump gear drive.

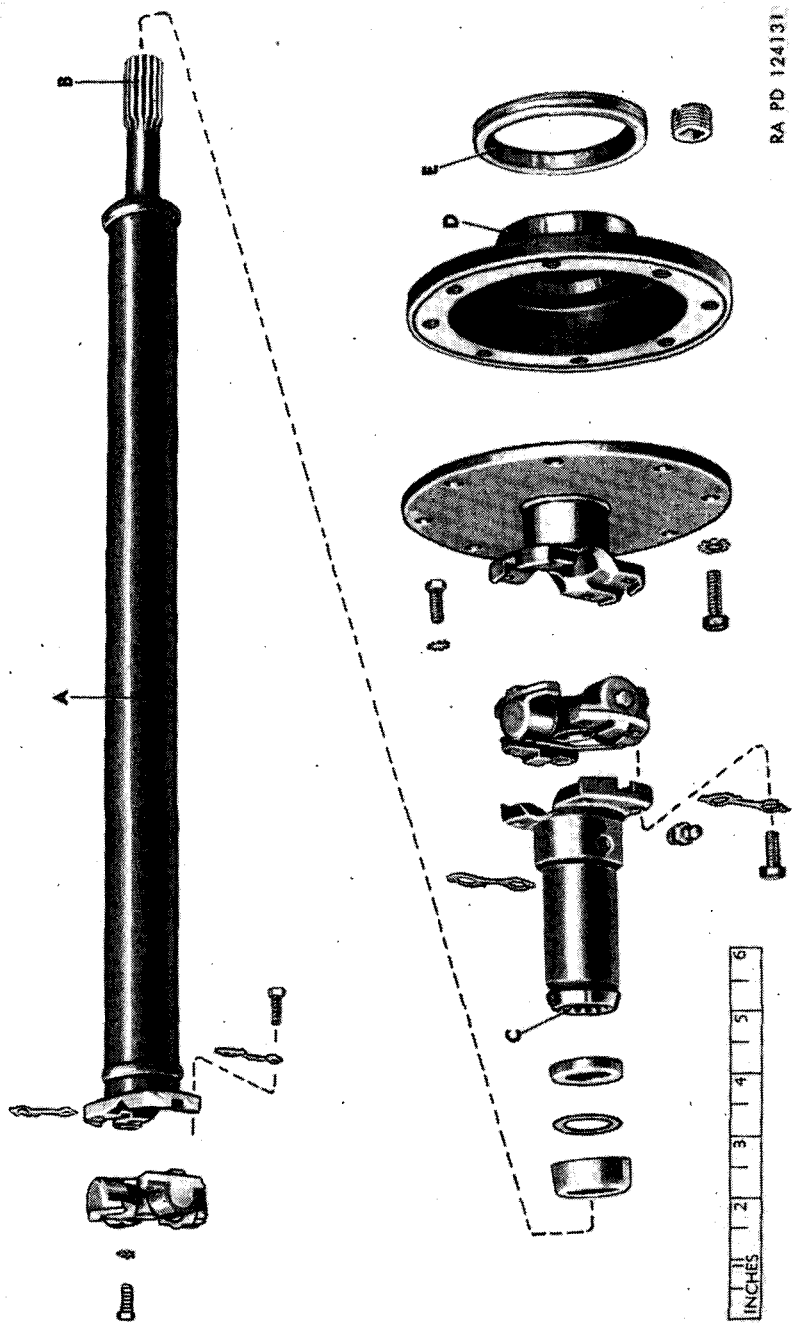


Figure 76. Repair and rebuild standards reference points—hydraulic-pump propeller shaft.

144. Emergency-Lift Hand-Operated Pump

<i>Figure No.</i>	<i>Reference letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>
77-----	A-----	Four check-valve balls must be round to within.	0.0001 in.
77-----	B-----	ID of plunger-operating-lever-pin bore in plunger-operating lever.	0.4395 to 0.4405 in.
77-----	C-----	OD of plunger-operating-lever boss	0.4930 to 0.4970 in.
77-----	D-----	OD of plunger-operating-lever pin	0.4370 to 0.4375 in.
77-----	B-D----	Clearance between plunger-operating-lever pin and plunger-operating lever.	0.0020 to 0.0035 in.
77-----	E-----	ID of plunger bore in pump housing.	0.5630 to 0.5635 in.
77-----	F-----	ID of plunger-operating-lever-boss bore in plunger.	0.5030 to 0.5070 in.
77-----	F-C----	Clearance between plunger-operating-lever boss and plunger.	0.0060 to 0.0140 in.
77-----	G-----	OD of plunger-----	0.5615 to 0.5620 in.
77-----	E-G----	Clearance between plunger and pump housing.	0.0010 to 0.0020 in.

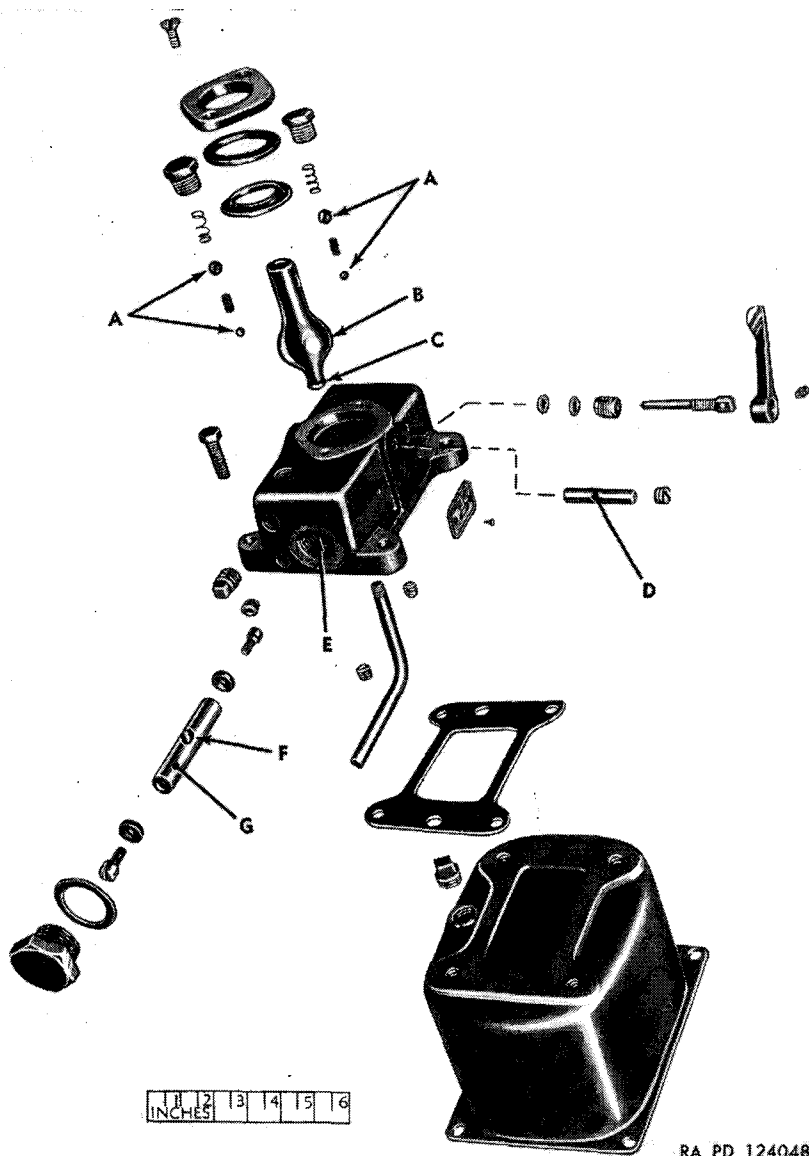


Figure 77. Repair and rebuild standards reference points—hand-operated pump.

CHAPTER 5

SHIPMENT AND LIMITED STORAGE AND DESTRUCTION OF MATÉRIEL TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

145. Domestic Shipping and Limited Storage Instructions

a. DOMESTIC SHIPPING INSTRUCTIONS.

- (1) *Preparation.* When shipping the tank-mounting bulldozer M3 (either mounted on the medium tank M46 or crated) interstate or within the zone of interior, the officer in charge of preparing the shipment *will be responsible* for furnishing matériel to the carriers for transport in a *serviceable* condition properly cleaned, preserved, painted, lubricated, etc., as prescribed in SB 9-4.

Caution: Personnel withdrawing matériel from a limited-storage status for domestic shipment must not remove preservatives other than to insure that matériel is complete and serviceable. If preservatives have been removed, they must be restored prior to shipment. The removal of preservatives is the responsibility of depots, ports, or field installations (posts, camps, and stations) receiving the shipments.

- (2) *Preparation for shipment to ports.*

(a) *Inspection.* All used vehicles equipped with tank-mounting bulldozers M3 destined for oversea use will be inspected prior to shipment in accordance with standards given in TB ORD 385.

(b) *Processing for shipment to ports.* All vehicles equipped with tank-mounting bulldozers M3 destined to ports of embarkation for oversea shipment will be further processed in accordance with SB 9-4.

Note. Ports of embarkation will supplement any necessary or previously omitted processing upon receipt of vehicle.

- (3) *Army shipping documents.* Prepare all Army shipping documents accompanying freight in accordance with TM 38-705.

b. LIMITED STORAGE INSTRUCTIONS.

- (1) *General.*

(a) Matériel received already processed for domestic shipment

as indicated on the vehicle processing record tag, WD AGO Form 9-3, need not be reprocessed unless the inspection performed on receipt of vehicles reveals corrosion, deterioration, etc.

- (b) Completely process matériel prior to storage if the processing data recorded on the tag indicates matériel has been rendered ineffective by operation freight shipping damage, or upon their receipt directly from manufacturing facilities.
 - (c) Matériel to be prepared for limited storage must be given a limited technical inspection and processed as prescribed in SB 9-63. The results and classification of the vehicle will be entered on DA AGO Form 461-5.
- (2) *Receiving inspections.*
- (a) Report of matériel received in a damaged condition or improperly prepared for shipment will be reported on DD Form 6 in accordance with SR 745-45-5. Report of matériel received in an unsatisfactory condition (chronic failure or malfunction of the matériel or equipment) will be reported on Unsatisfactory Equipment Report (DA AGO Form 468) in accordance with SR 700-45-5.
 - (b) The tank-mounting bulldozer M3 is received from the manufacturer with the loose parts packed in suitable crates, and the moldboard assembly secured by steel straps to a heavy wooden skid (fig. 4). Unpack the units as prescribed in paragraph 8.

Note. The bulldozer is installed on the medium tank M46, and becomes an integral part of the tank after installation (par. 9).

- (c) Immediately upon receipt of tank-mounting bulldozers, either mounted or boxed, they must be inspected and serviced as prescribed in section I, chapter 2. Perform a systematic inspection and replace or repair all missing or broken parts. If repairs are beyond the scope of the unit and the matériel will be out-of-service for an appreciable length of time, store them in a limited-storage status and attach a tag to the matériel specifying the repairs needed. The report of these conditions will be submitted by the unit commander for action by an ordnance maintenance unit.
- (3) *Inspections during storage.* Perform a visual inspection periodically to determine general condition. If corrosion is found on any part, remove the rust spots, clean, paint, and treat with the prescribed preservatives.

Note. Touch-up painting will be in accordance with TM 9-2851.

(4) *Removal from limited storage.*

- (a) If the bulldozers are not shipped or issued upon expiration of the limited storage period, they may either be processed for another limited storage period or be further treated for stand-by storage (matériel inactivated for periods in excess of 90 days up to 3 years) by ordnance maintenance personnel.
 - (b) If bulldozers to be shipped will reach their destination within the scope of the limited storage period, they need not be reprocessed upon removal from storage unless inspection reveals it to be necessary according to anticipated in-transit weather conditions.
 - (c) Deprocess bulldozers when it has been ascertained that they are to be placed into immediate service. Remove all rust-preventive compounds and thoroughly lubricate as prescribed in paragraph 52. Inspect and service bulldozers as prescribed in paragraph 56.
 - (d) Repair and/or replace all items tagged in accordance with (2) (c) above.
- (5) *Storage site.* The preferred type of storage for bulldozers is under cover in open sheds or warehouses whenever possible. Where it is found necessary to store bulldozers outdoors, they must be protected against the elements as prescribed in TB ORD 379.

146. Loading and Blocking Medium Tank M46 With Tank-Mounting Bulldozer M3

a. SHIPPING INSTRUCTIONS. Load and block the medium tank M46 on the freight car as prescribed in TM 9-718.

Note. Prior to loading tank on freight car, the bulldozer moldboard must be placed in the raised position.

b. BULLDOZER BLOCKING INSTRUCTIONS.

Note. The removal of the tow lugs from the front of the tank for installation of the bulldozer necessitates the use of strapping in lieu of eye bolts and clamping bar for securing the front of tank to the flatcar.

- (1) *Lower the moldboard.* After vehicle has been positioned on the flatcar, lower the moldboard until it rests on car floor.
- (2) *Brake wheel clearance "A."* Load vehicles on cars with a minimum clearance of at least 4 inches below and 6 inches above, behind, and to each side of the brake wheel (fig. 78). Increase clearance as much as is consistent with the proper location of load.
- (3) *Moldboard blocking, "B," figure 78* (2 x 6-inch cleats, length

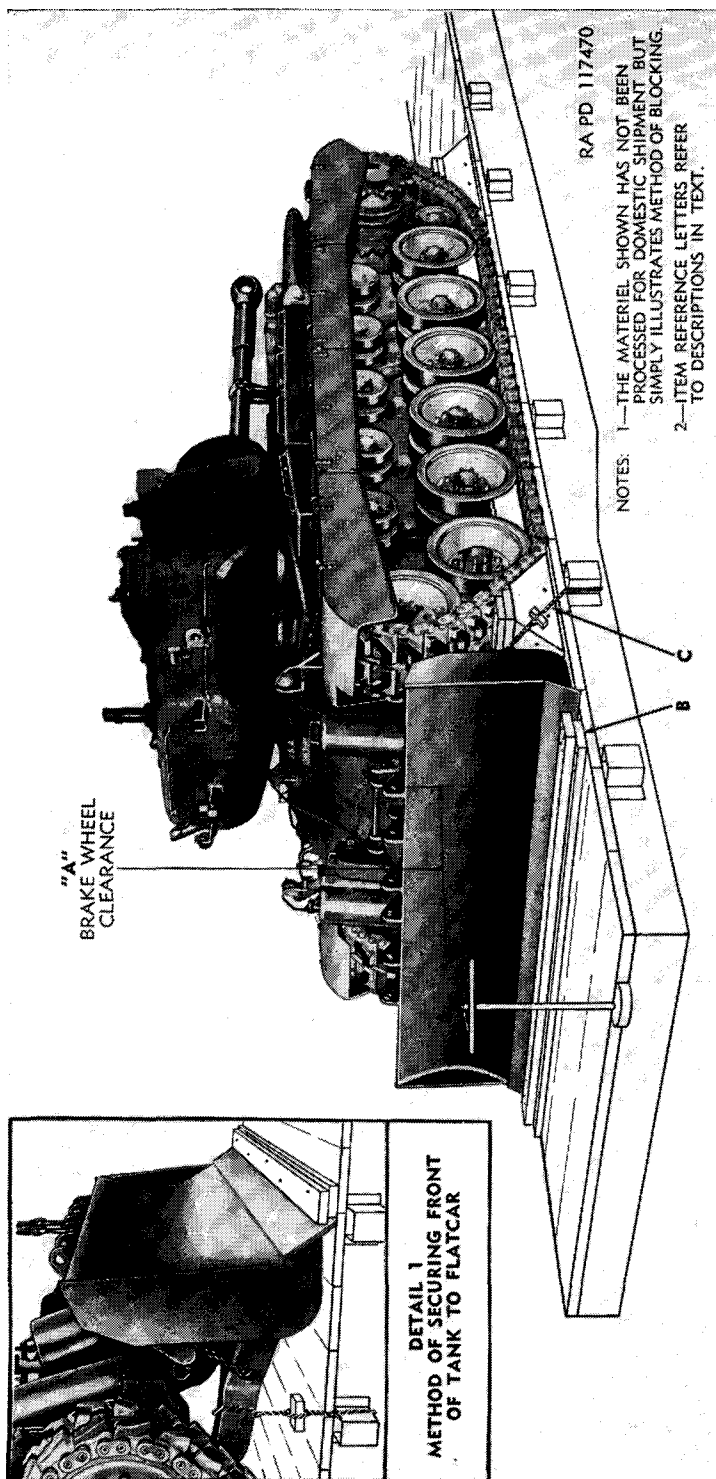


Figure 78. Method of blocking medium tank M46 with bulldozer M3 for rail shipment.

- to suit 2 required). Locate one cleat "B" across car floor against front of moldboard. Nail cleat to car floor with forty-penny nails staggered along its length. Place the other cleat "B" on top of lower cleat against moldboard. Nail upper cleat to lower cleat and car floor with forty-penny nails.
- (4) *Strapping, "C," figure 78, detail 1 (6 strands No. 8 gage black annealed wire)*. Cut six strands of wire long enough to extend from the right push beam to a stake pocket on the right side of flatcar. Twist wires together to form a cable. Pass one end of the cable around the push beam and extend the end through the stake pocket, bringing the end back toward the push beam beyond the point half-way between the push beam and stake pocket. Form a 6-inch loop in the cable end, twisting wires tightly around the cable. Pass the free end of the cable through the 6-inch loop forming another loop. Insert a tightening tool in one of the loops. Place a random length 2 x 2-inch block between the cables. Using the tightening tool, twist the cables just taut enough to take up all slack. Retain the 2 x 2-inch block in place between cables to maintain a tightening tool aperture for future tightening of strapping if necessary. Repeat the operation for securing left push beam to a left side stake pocket, securing front of vehicle to the flatcar.

Section II. DESTRUCTION OF MATÉRIEL TO PREVENT ENEMY USE

147. General

a. Destruction of the tank-mounting bulldozer M3, when subject to capture or abandonment in the combat zone, will be undertaken by the using arm only when, in the judgment of the unit commander concerned, such action is necessary in accordance with orders of, or policy established by, the army commander.

b. The information which follows is for guidance only. Certain of the procedures outlined require the use of explosives and incendiary grenades which normally may not be authorized items for the bulldozer. The issue of these and related materials, and the conditions under which destruction will be effected, are command decisions in each case, according to the tactical situation. Of the several means of destruction, those most generally applicable are—

Mechanical—Requires axe, pick mattock, sledge, crowbar, or similar implement.

Burning—Requires gasoline, oil, incendiary grenades, or other inflammables.

Demolition—Requires suitable explosives or ammunition.

Gunfire—Includes artillery, machine guns, rifles using rifle grenades, and launchers using antitank rockets. Under some circumstances hand grenades may be used.

In general, destruction of essential parts, followed by burning will usually be sufficient to render the matériel useless. However, selection of the particular method of destruction requires imagination and resourcefulness in the utilization of the facilities at hand under the existing conditions. Time is usually critical.

a. If destruction to prevent enemy use is resorted to, the bulldozer must be so badly damaged that it cannot be restored to a usable condition in the combat zone either by repair or cannibalization. Adequate destruction requires that all parts essential to the operation of the bulldozer, including essential spare parts, be destroyed or damaged beyond repair. However, when lack of time and personnel prevents destruction of all parts, priority is given to the destruction of those parts most difficult to replace. Equally important, the same essential parts must be destroyed on all bulldozers so that the enemy cannot construct one complete unit from several damaged ones.

d. If destruction is directed, due consideration should be given to—

- (1) Selection of a point of destruction that will cause greatest obstruction to enemy movement and also prevent hazard to friendly troops from fragments or ricocheting projectiles which may occur incidental to the destruction.
- (2) Observance of appropriate safety precautions.

148. Destruction of the Tank-Mounting Bulldozer M3

Note. The following instructions contain a method of destruction to be used only when the bulldozer is separate from the tank. If the bulldozer has been assembled to the medium tank M46 and both are to be destroyed, the charges described below for destruction of the bulldozer should be connected for simultaneous detonation with the charges set for destruction of the tank. Refer to TM 9-718.

Method by demolition.

a. Prepare five 2-pound charges of **EXPLOSIVE**, TNT (using two 1-lb. blocks or equivalent together with the necessary detonating cord to make up each charge). Set the charges as follows:

- (1) *One* charge on the *left*-inner-tilt-arm bracket and *one* charge on the *right*-inner-tilt-arm bracket.
- (2) *One* charge on the *left* push beam bracket and *one* charge on the *right* push beam bracket.
- (3) *One* charge between the *two* hydraulic cylinders. Connect the *five* charges for simultaneous detonation with detonating cord.

b. Provide for dual priming to minimize the possibility of a misfire. For priming, either a nonelectric blasting cap crimped to at least 5 feet of safety fuze (safety fuze burns at the rate of 1 foot in 30 to 45 seconds—test before using) or an electrical blasting cap and firing wire may be used. Safety fuze, which contains black powder, and blasting caps must be protected from moisture at all times. The safety fuze may be ignited by a fuze lighter or a match; the electric blasting cap requires a blasting machine or equivalent source of electricity.

Caution: Keep the blasting caps, detonating cord, and fuze separated from the charges until required for use.

Note. For the successful execution of methods of destruction involving the use of demolition materials, all personnel concerned will be thoroughly familiar with the provisions of FM 5-25. Training and careful planning are essential.

c. Detonate the charges. If primed with nonelectric blasting cap and safety fuze, ignite and take cover. If primed with electric blasting cap, take cover before firing. Elapsed time: about 5 minutes.

APPENDIX

REFERENCES

1. Publication Indexes

The following publication indexes and lists of current issue should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to matériel covered in this manual:

Index of Administrative Publications (Army Regulations, Special Regulations, Readjustment Regulations, Joint Army-Air Force Adjustment Regulations, General Orders, Bulletins, Circulars, Commercial Traffic Bulletins, Joint Procurement Circulars, Department of the Army Pamphlets, and ASF Manuals).....	SR 310-20-5
Index of Army Training Publications (Field Manuals, Training Circulars, Firing Tables and Charts, Army Training Programs, Mobilization Training Programs, Graphic Training Aids, Joint Army-Navy Air Force Publications, and Combined Communications Board Publications).....	SR 310-20-3
Index of Army Motion Pictures and Film Strips.....	SR 110-1-1
Index of Blank Forms and Army Personnel Classification Tests.....	SR 310-20-6
Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, Modification Work Orders, Tables of Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, Tables of Equipment.....	SR 310-20-4
Introduction and Index (supply catalogs).....	ORD 1
Military Training Aids.....	FM 21-8
Ordnance Major Items and Combinations and Pertinent Publications..	SB 9-1

2. Supply Catalogs

The following catalogs of the Department of the Army Supply Catalog pertain to this matériel:

a. DESTRUCTION TO PREVENT ENEMY USE.

Land Mines and Fuzes, Demolition Material, and Ammunition for Simulated Artillery and Grenade Fire..... ORD 11 SNL R-7

b. MAINTENANCE AND REPAIR.

Antifriction Bearings and Related Items..... ORD 5 SNL H-12
Cleaners, Preservatives, Lubricants, Recoil Fluids, Special Oils, and Related Maintenance Materials..... ORD 3 SNL K-1
Items of Soldering, Metallizing, Brazing, and Welding Materials; Gases and Related Items..... ORD 3 SNL K-2

Lubricating Equipment, Accessories, and Related Dispensers_	ORD (*) SNL K-3
Major Items and Major Combinations of Group G_	ORD 3 SNL G-1
Miscellaneous Hardware_	ORD 5 SNL H-2
Oil Seals_	ORD 5 SNL H-13
Ordnance Maintenance Sets_	ORD 6 SNL N-21
Pipe and Hose Fittings_	ORD 5 SNL H-6
Standard Hardware_	ORD 5 SNL H-1
Tool Sets (Special), Motor Vehicles_	ORD 6 SNL G-27, Sec 1
Tool Sets (Common), Specialists and Organizational_	ORD 6 SNL G-27, Sec 2

c. VEHICLE.

Bulldozer, Tank-Mounting, M3_	ORD (*) SNL G-246
Tank, Medium, M46_	ORD (*) SNL G-244

3. Forms

The following forms are applicable to this matériel :

WD AGO Form 9-71, Locator and Inventory Control Card.
 WD AGO Form 9-72, Ordnance Stock Record Card.
 WD AGO Form 9-76, Request for Work Order.
 WD AGO Form 9-77, Job Order Register.
 WD AGO Form 9-78, Job Order.
 WD AGO Form 9-79, Parts Requisition.
 WD AGO Form 9-80, Job Order File.
 WD AGO Form 9-81, Exchange Part or Unit Identification Tag.
 WD AGO Form 460, Preventive Maintenance Roster.
 WD AGO Form 461-5, Limited Technical Inspection.
 WD AGO Form 468, Unsatisfactory Equipment Report.
 WD AGO Form 478, MWO and Major Unit Assembly Replacement
 Records and Organizational Equipment File.
 WD AGO Form 811, Work Request and Job Order.
 WD AGO Form 811-1, Work Request and Hand Receipt.
 WD AGO Form 865, Work Order.
 WD AGO Form 866, Consolidation of Parts.
 WD AGO Form 867, Status of Modification Work Order.
 DD Form 6, Report of Damaged or Improper Shipment.

4. Other Publications

The following explanatory publications contain information pertinent to this matériel and associated equipment :

a. CAMOUFLAGE.

Camouflage_	TM 5-267
Camouflage, Basic Principles_	FM 5-20
Camouflage of Vehicles_	FM 5-20B

(*) See ORD 1, Introduction and Index, for published catalogs of the Ordnance section of the Department of the Army Supply Catalog.

b. DECONTAMINATION.

Decontamination	TM 3-220
Decontamination of Armored Force Vehicles	FM 17-59
Defense Against Chemical Attack	FM 21-40

c. DESTRUCTION TO PREVENT ENEMY USE.

Explosives and Demolitions	FM 5-25
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d. GENERAL.

Cooling Systems: Vehicles and Powered Ground Equipment	TM 9-2858
Driver Selection, Training and Supervision, Half-Track and Full-Track Vehicles	TM 21-301
General Safety Manual	TM 20-350
Inspection of Ordnance Matériel	TM 9-1100
Manual for the Full-Track Vehicle Driver	TM 21-306
Military Vehicles	TM 9-2800
Preparation of Ordnance Matériel for Deep-Water Fording	TM 9-2853
Principles of Automotive Vehicles	TM 9-2700
Supplies and Equipment: Unsatisfactory Equipment Report	SR 700-45-5

e. REPAIR AND REBUILD.

Maintenance of Supplies and Equipment: Maintenance Responsibilities and Shop Operation	AR 750-5
Cleaning, Preserving, Sealing, and Related Materials Issued for Ordnance Matériel	TM 9-850
Hand, Measuring, and Power Tools	TM 10-590
Instruction Guide: Care and Maintenance of Ball and Roller Bearings	TM 37-265
Lubrication	TM 9-2835
Maintenance and Care of Hand Tools	TM 9-867
Modification of Ordnance Matériel	SB 9-38
Motor Vehicle Inspection and Preventive Maintenance Services	TM 37-2810
Painting Instructions for Field Use	TM 9-2851

f. SHIPMENT AND LIMITED STORAGE.

Army Marking Directive	TM 38-414
Army Shipping Document	TM 38-705
Instruction Guide: Ordnance Packaging and Shipping (Posts, Camps, and Stations)	TM 9-2854
Ordnance Storage and Shipment Chart—Group G	TB 9-OSSC-G
Preparation of Unboxed Ordnance Matériel for Shipment	SB 9-4
Protection of Ordnance General Supplies in Open Storage	TB ORD 379
Shipment of Supplies and Equipment: Report of Damaged or Improper Shipment	SR 745-45-5
Standards for Oversea Shipment and Domestic Issue of Ordnance Matériel other than Ammunition and Army Aircraft	TB ORD 385
Storage, Inspection, and Issue of Unboxed Serviceable Motor Vehicles; Preparation of Unserviceable Vehicles for Storage and Deprocessing of Matériel Prior to Operation	SB 9-63

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